

# R&S® RTP HIGH-PERFORMANCE OSCILLOSCOPE

## Signal integrity in real time

Oscilloscope innovation. Measurement confidence.

[www.rohde-schwarz.com/RTP](http://www.rohde-schwarz.com/RTP)



Product Brochure  
Version 15.00

**ROHDE & SCHWARZ**

Make ideas real



# AT A GLANCE

Benefit from the advanced technology in the R&S®RTP oscilloscope. Customized frontend ASICs and real-time processing hardware enable highly accurate measurements up to 16 GHz with unprecedented speed in a compact form factor.

The R&S®RTP high-performance oscilloscope combines high-class signal integrity with fast acquisition and analysis. The Rohde&Schwarz designed frontend components offer an expandable oscilloscope platform from 4 GHz to 16 GHz. Dedicated acquisition and processing ASICs enable an unprecedented high acquisition and processing rate of 750 000 waveforms/s. The high-precision digital trigger catches the smallest signal anomalies and operates with the hardware based clock data recovery (CDR) on embedded clock signals up to the industry-leading data rate of 16 Gbps.

The R&S®RTP is the world's first oscilloscope to compensate the impairment of the signal contacting in real time while maintaining the high acquisition rate. Hardware based compensation filters are configured using user-applied S-parameters. The real-time math module directly after the compensation filters makes it possible to even trigger on deembedded differential and common mode signals.



The R&S®RTP oscilloscope combines multiple instrument capabilities for time-correlated debugging in one box. Additional integrated test resources such as MSO, arbitrary waveform generator, 16 GHz differential pulse source and multiple 18-bit high-precision voltage and current channels make the R&S®RTP the most powerful debugging tool. With all this in a compact instrument format plus silent operation, the R&S®RTP oscilloscope is the best fit for any lab.



# BENEFITS

## Real-time signal integrity

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## Multi-instrument capability

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## Compact and configurable

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## Comprehensive probe portfolio

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# OSCILLOSCOPE MODELS

## Bandwidth

- ▶ **R&S®RTP164:** 16 GHz (2 channels)/8 GHz (4 channels)
- ▶ **R&S®RTP134:** 13 GHz (2 channels)/8 GHz (4 channels)
- ▶ **R&S®RTP084:** 8 GHz (4 channels)
- ▶ **R&S®RTP064:** 6 GHz (4 channels)
- ▶ **R&S®RTP044:** 4 GHz (4 channels)

## Sampling rate

- ▶ 40 Gsample/s (2 channels), 20 Gsample/s per channel

## Acquisition memory

- ▶ 50 Msample per channel
- ▶ max. 2 Gsample

## Acquisition rate

- ▶ 750 000 waveforms/s

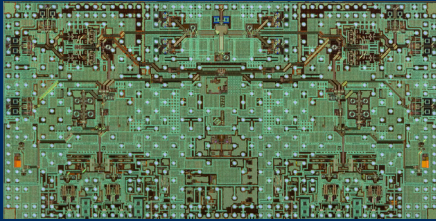
## Mixed signal analysis (MSO) with 16 digital channels

- ▶ 400 MHz bandwidth
- ▶ 5 Gsample/s sampling rate
- ▶ 200 Msample memory depth

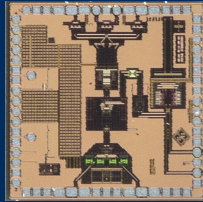
# OSCILLOSCOPE INNOVATION. MEASUREMENT

## ENABLING TECHNOLOGIES

Rohde & Schwarz engineers focus on making oscilloscopes better. They use leading-edge technologies for hardware and software designs and incorporate innovative features such as fastest signal acquisition, an entirely new trigger architecture and the touchscreen-optimized user interface. The new R&S®RTP high-performance oscilloscope family continues this tradition of innovation and offers a true first: high-performance signal integrity in real time in a compact instrument.

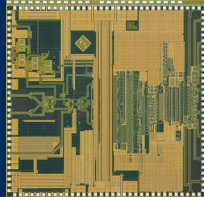


Rohde & Schwarz in-house designed integrated circuits



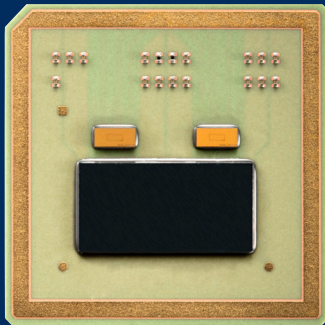
### High-performance analog ASICs

Measurement accuracy is highly dependent on the components in the signal path, e.g. amplifiers, samplers and A/D converters. Rohde & Schwarz uses its in-house expertise to design the best analog integrated circuits. Users benefit from low noise, high measurement dynamic range and extremely temperature-stable results.



### Leading-edge multi-chip modules

Rohde & Schwarz uses multi-chip modules to combine the best of the different technologies for excellent frontend performance. As a critical component for both signal integrity and ruggedness, the termination resistor is manufactured with in-house technologies and laser-trimmed for precise input matching.

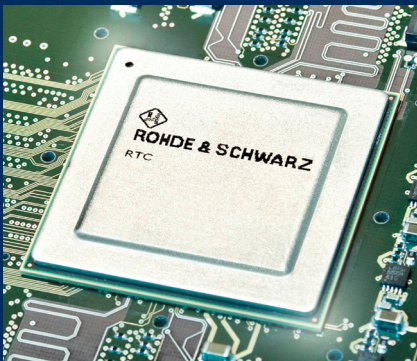


R&S®RTP multi-chip frontend module



### Fastest throughput processing – ASIC

A high acquisition and processing rate supports fast detection of rare signal faults and ensures a responsive instrument during operation. The highly integrated Rohde & Schwarz ASIC is capable of running multiple parallel processes, which dramatically reduces blind time.

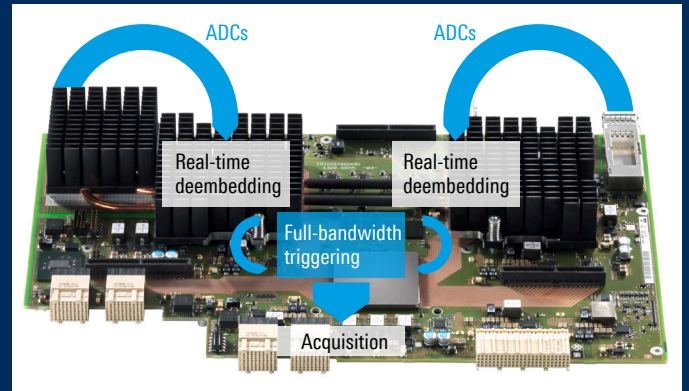


R&S®RTP processing ASIC

# MENT CONFIDENCE.

## Real-time deembedding and advanced triggering

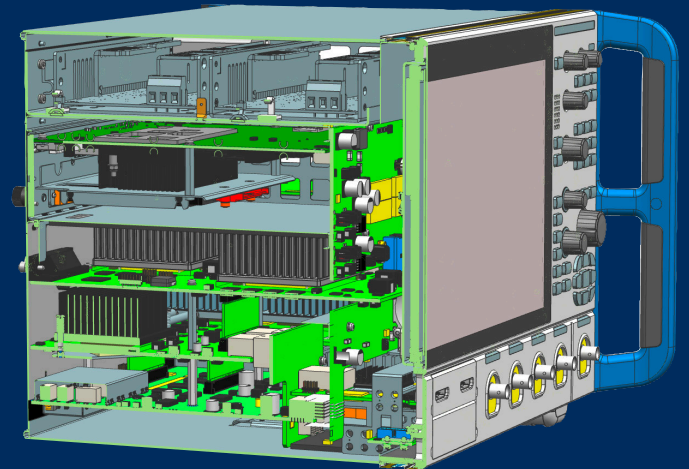
The R&S®RTP features powerful processing components directly after the A/D converters for real-time correction of the transmission path from the DUT. The unique Rohde & Schwarz digital trigger system follows in the processing path and operates based on the same compensated A/D converter samples. Users benefit from highest acquisition speed even with activated real-time deembedding and precise triggering on compensated signal events up to the full bandwidth.



R&S®RTP real-time deembedding and trigger board

## Quiet and compact

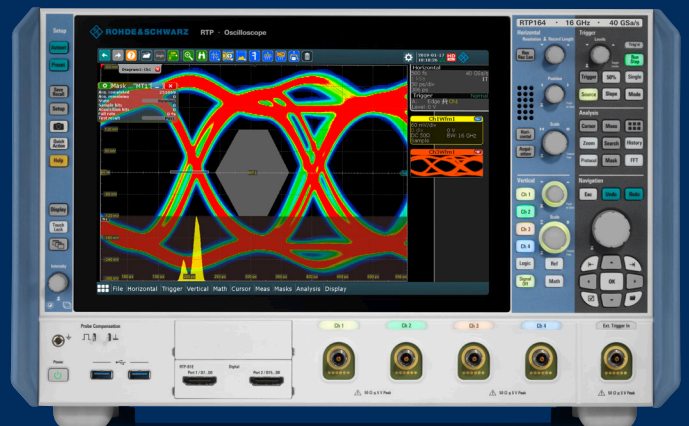
The R&S®RTP instrument platform is designed for minimal bench space and lowest acoustic noise. Managing power consumption is critical in such a highly integrated instrument. Sophisticated temperature management starts with the hardware design, uses advanced head spreading concepts and includes an optimized air flow design. Users in the lab will enjoy a compact, extremely quiet instrument.



Extremely compact layout of the R&S®RTP

## Premium front panel design

The 12.1" high-resolution capacitive touch display is embedded in a precisely milled solid aluminum front panel. This high-quality, long lifetime design supports precise operation of the touchscreen even in the corners. Multicolor LEDs at the channel inputs and on various sections of the front panel guide users intuitively. Key components of the Rohde & Schwarz graphical user interface, such as the multiple diagrams and unit annotation, have become established industry standards.



R&S®RTP premium front panel

# REAL-TIME SIGNAL INTEGRITY

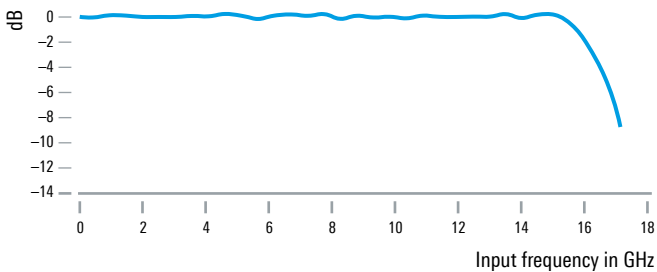
## HIGH-PERFORMANCE FRONTEND

### Flat frequency response and high SFDR for precise and fast measurements

The input components of the R&S®RTP assure high measurement fidelity without time-consuming correction during postprocessing. Users benefit from reliable results with the industry-leading acquisition rate of > 750 000 waveforms/s.

The R&S®RTP is ideal for precise measurements on high speed signals and wideband RF applications due to its flat frequency response, high effective number of bits and large spurious free dynamic range (SFDR excl. harmonics > 60 dBc).

### Flat frequency response of the R&S®RTP164



### High input sensitivity of 2 mV/div for small signals

The instrument supports measurement of small signals thanks to its high vertical input sensitivity down to 2 mV/div without software magnification or limitations on the maximum measurement bandwidth.

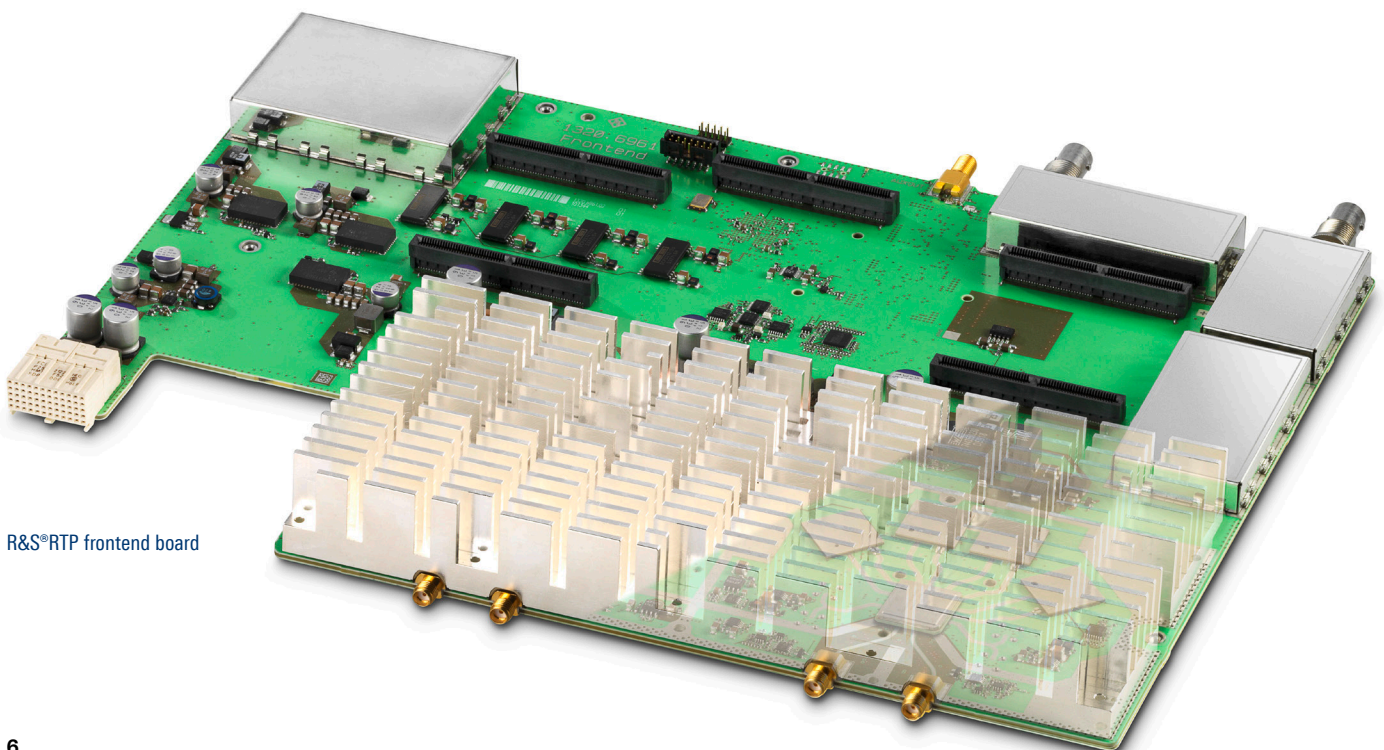
In combination with the sophisticated shielding design, a channel-to-channel isolation of > 50 dB maintains the high measurement accuracy for multichannel measurements.

### High temperature stability for consistent results

The design of the R&S®RTP frontend is optimized for almost zero DC drift and high temperature stability. Measure without the interruption of updating calibration steps during the day. The tight temperature control of the R&S®RTP ensures stable results. And the speed-controlled fan keeps the acoustic noise at a whisper level.

### Low intrinsic jitter

The sampling clock for the A/D converters is optimized for low intrinsic jitter. It uses an oven-controlled crystal oscillator (OCXO) as a reference. This ensures long-term jitter stability for acquisitions with deep memory up to 2 Gsample.



R&S®RTP frontend board

# REAL-TIME DEEMBEDDING

## Deembedding in real time for fast results

The R&S®RTP extends traditional deembedding capabilities with flexible filter structures directly after the A/D converters. This allows waveform correction in real time. The advantages over deembedding the acquired waveform during postprocessing are the measurement speed and instrument responsiveness.

With real-time deembedding on, the R&S®RTP retains the maximum acquisition rate of > 750 000 waveforms/s. Debugging tasks such as searching for sporadic signal faults and eye diagram analysis are achieved in a fraction of time.

## Correction of cascaded signal paths

A cascade of signal path blocks can be defined for deembedding. The individual blocks are described by S-parameters that can be derived from simulation or measured with a vector network analyzer. Alternatively, the R&S®RTP-B7 pulse source option can be used to measure the transmission loss of the complete signal path. For both approaches, the deembedding software automatically calculates the correction filter for the overall system response.

## Triggering on corrected signals

With the R&S®RTP, for the first time users can trigger on corrected waveforms and focus on debugging the true device characteristics. The unique digital trigger system operates with the sampling points of the A/D converter and the real-time deembedding filters. The trigger evaluates the real device signal since the distortion effects of the measurement path have been removed.

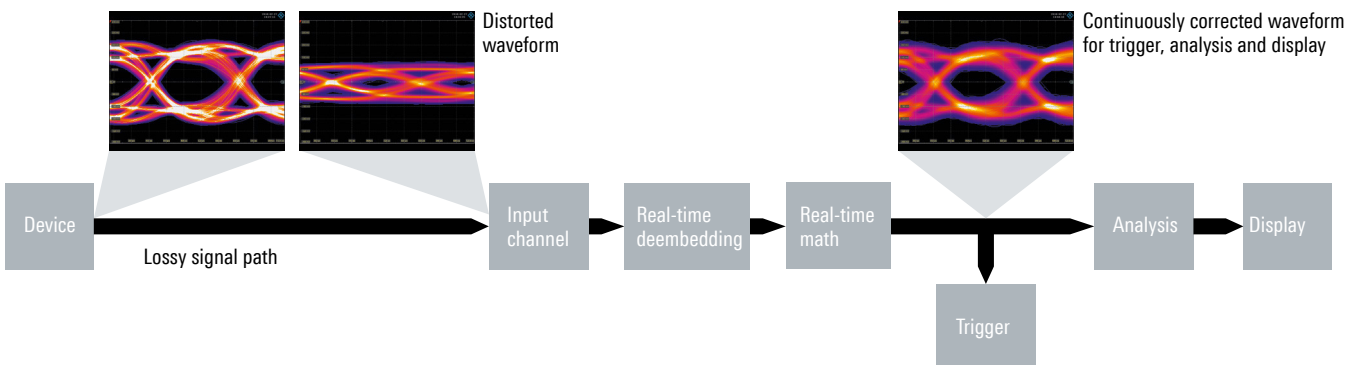
## Real-time math for differential signals

The R&S®RTP features a math module directly after the real-time deembedding and before the trigger system. It supports add, subtract and common mode calculation for any two input channels. This enables fast analysis of differential signals, including triggering on the differential or common mode voltage. Additionally, the math module allows inversion of the input signals.

## Full bandwidth for all trigger types

The powerful trigger system of the R&S®RTP goes beyond the limits of traditional high-performance oscilloscopes. In addition to the edge trigger, advanced trigger types such as pulse width, runt and setup&hold work up to the full bandwidth of the instrument. This enables fast isolation of high-frequency signal components. The trigger sensitivity is adjustable from 0 div to 5 div and the trigger resolution can be extended up to 16 bit with the high definition mode. Users can reliably trigger on even the smallest signal details.

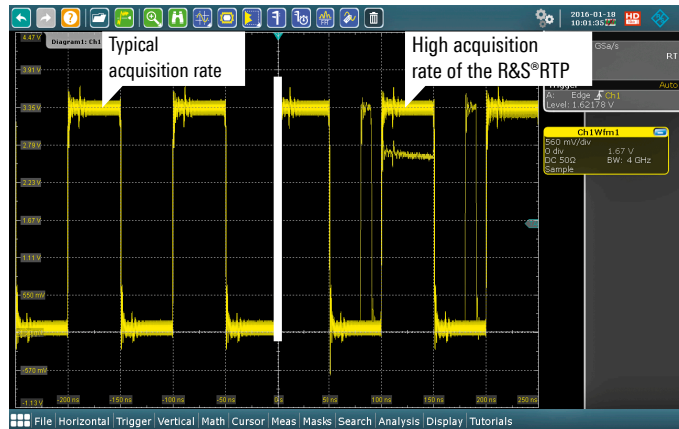
## Real-time deembedding architecture



# HARDWARE-ACCELERATED PROCESSING FOR FAST RESULTS

## Quickly find signal faults with > 750 000 waveforms/s

The R&S®RTP oscilloscopes process and display more than 750 000 waveforms/s in standard operating mode. This allows you to detect sporadic signals quickly and reliably. This update rate is unique for high-performance oscilloscopes. A high acquisition rate is even available when zoom or cursor measurements are active.



The high acquisition rate detects sporadic signal faults fast

## Increase real-time resolution with 16-bit HD mode

The low-noise frontend and single-core A/D converters are the foundation for the high measurement accuracy and dynamic range of the R&S®RTP oscilloscopes. The high definition (HD) mode activates configurable low-pass filtering of the signal after the A/D converters. The hardware implemented filters reduce the noise in real time, effectively increasing the signal-to-noise ratio. Users can adjust the filter bandwidth and increase the vertical resolution stepwise. The maximum resolution of 16 bit is achieved at 200 MHz bandwidth.

With the Rohde&Schwarz 16-bit HD mode, even the digital trigger system benefits from the increased resolution, making it possible to trigger on the smallest signal details.



The 16-bit HD mode makes signals details visible that are otherwise hidden in noise

## Resolution as a function of the filter bandwidth

Filter	Resolution
Inactive	8 bit
2 GHz	10 bit
1 GHz	11 bit
500 MHz	12 bit
200 MHz to 10 kHz	16 bit

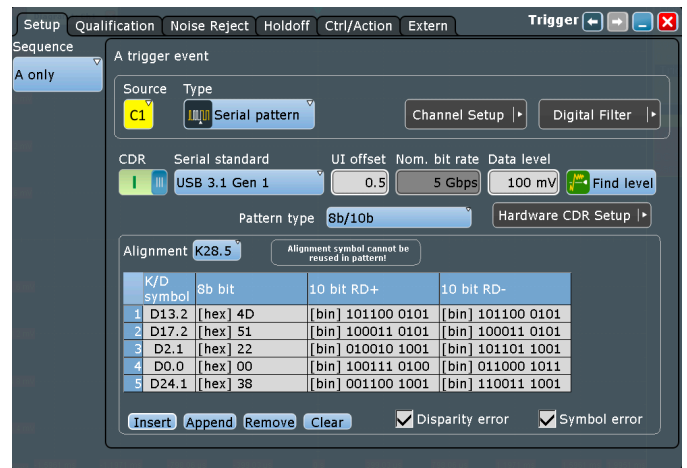


## Analyze high speed serial signals with the serial pattern trigger and 16 Gbps clock data recovery

The R&S®RTP features a high speed serial pattern trigger that can operate based on the extracted embedded clock of a serial signal. The R&S®RTP accomplishes this with hardware based clock data recovery (CDR) that supports a maximum nominal data rate of 8 Gbps or 16 Gbps, depending on the selected software option.

The CDR can use any of the four analog input channels. This function can be added as an upgrade at any time since the options are license key enabled.

The high speed serial pattern trigger supports a variety of trigger events, including user-defined bit streams up to 160 bit and various decoding schemes such as 8B/10B or 128B/132B. By triggering on a “1” or a “0”, an eye diagram for NRZ data is easily generated. For further signal integrity analysis, eye mask test and histogram functions are available.



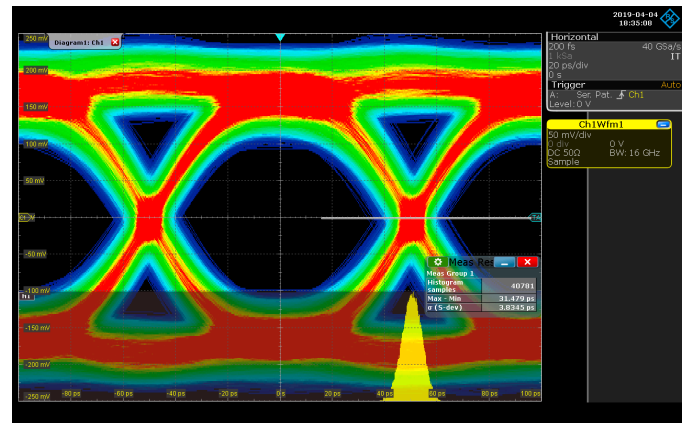
Setup dialog for the high speed serial pattern trigger

Parameter	Value range
CDR bit rate	
R&S®RTP-K140/K141 option	21 kbps to 8 Gbps/16 Gbps
Trigger type	
Single-bit pattern	up to 160 bit
Dual-bit pattern	2-bit pattern up to 160 bit
Complex word	frame alignment; up to 4-bit pattern, logical conditions
PRBS error	7, 9, 11, 15, 16, 17, 20, 23, 29, 31
Decoding	8B/10B, 128B/130B, 128B/132B

## Fast eye mask test and histogram

With the R&S®RTP oscilloscope, mask tests and the histogram display are hardware accelerated and deliver fast results with high statistical confidence. Signal anomalies and unexpected results are quickly identified. You can define a new mask directly on the display in just a few steps. Each mask can consist of up to eight segments.

The histogram on the R&S®RTP oscilloscope is applicable on input signal levels (vertical) or transitions in the time-base (horizontal) to analyze noise and jitter. On each histogram, the statistical data can be displayed together with other measurement functions.



The high speed serial pattern trigger and the hardware based CDR enable fastest eye diagram measurements

# COMPREHENSIVE ANALYSIS TOOLS

## Jitter and noise analysis

### Powerful basic jitter analysis functions

R&S®RTP oscilloscopes offer a wide range of basic jitter analysis functions enabled by the R&S®RTP-K12 option. Automated jitter measurements like cycle-to-cycle jitter and time interval error (TIE) essential for jitter analysis on clock and data signals and for investigating further signal details with additional tools such as track, long-term trend and FFT on track. For example, frequency interference can be determined by applying FFT analysis to the cycle-to-cycle jitter measurement track.

### Jitter and noise measurement functions

R&S®RTP-K134 option	TJ (meas.)	TN (meas.)
R&S®RTP-K133 option	TJ (at BER)	EH (at BER)
R&S®RTP-K12 option	RJ	RN RN + OBUN
<b>Standard functions</b>	RJ + OBUJ	DN
Period	DJ	DDN
Frequency	DJ (δδ)	ISIN
Setup	DDJ	LD
Setup/hold time	ISI	PN
Setup/hold ratio	DCD	DDN + PN
	PJ	OBUN
	DDJ + PJ	OBUN (δδ)
	OBUJ	
	OBUJ (δδ)	

### Deep system insights with jitter and noise decomposition

Gain more insights into individual jitter and noise components of your transmitter interface to characterize the jitter and noise budget and identify the root causes of failures. The R&S®RTP-K133 and R&S®RTP-K134 options decompose jitter and noise into random (RJ/RN) and deterministic components such as data dependent (DDJ/DDN), periodic (PJ/PN) or other bounded uncorrelated components (OBUJ/OBUN). The Rohde & Schwarz decomposition algorithm calculates the step responses that fully characterize the deterministic behavior of the transmission system. The user benefits from accurate measurement results even for relatively short signal sequences. The R&S®RTP-K133 and R&S®RTP-K134 options provide additional functions to reconstruct synthetic eye diagrams and to calculate and display BER bathtub curves for selected components to understand their relevance to the overall system behavior. For in-depth analysis, the individual jitter and noise components can be displayed in histogram, track and spectrum view.



The intuitive setup dialog guides the user through the measurement and provides valuable background information.

Displays the step response, individual jitter and noise components in histograms, spectrum, synthetic eye diagram and BER bathtub curve of an 8 Gbps PCIe Gen3 signal.



# Automatic compliance tests

## Easy configuration and automatic control with R&S®ScopeSuite

R&S®ScopeSuite is generic compliance test software that runs on the R&S®RTP oscilloscope or on a separate Windows PC. It controls the measurement settings and test sequence on the R&S®RTP and guides you through all selected tests. Detailed, image based instructions make it easy to correctly connect the oscilloscope, the probes, the test fixture and the device under test. User data, all test setup settings and measurement report definitions are simple to configure. The limit editor lets you individually adjust test limits.

## Flexible test execution

For debugging during development or for stability verification, single tests and test sequences can be repeated. Limit lines and other parameters can be adjusted for each test repetition.

## Configurable reports for result documentation

Documenting the measurement results is an essential part of compliance tests. The R&S®ScopeSuite offers an extensive range of documentation functions. You can add measurement details and screenshots to the pass/fail results. The available output formats are PDF, DOC and HTML.

## Compliance test options

Interface standard	Compliance test option
<b>USB</b>	
USB 1.0/1.1/2.0/HSIC	R&S®RTP-K21
USB 3.2 Gen1/Gen2	R&S®RTP-K101
<b>Ethernet</b>	
10BASE-T1L/S Ethernet	R&S®RTP-K89
10/100 Mbit Ethernet	R&S®RTP-K22
1 Gbit Ethernet	R&S®RTP-K22
2.5G/5GBASE-T Ethernet	R&S®RTP-K25
10 Gbit Ethernet	R&S®RTP-K23
10M/100M/1GBASE-T Energy Efficient Ethernet	R&S®RTP-K86
<b>Automotive Ethernet</b>	
10BASE-T1S/L Ethernet	R&S®RTP-K89
100BASE-T1 BroadR-Reach® Ethernet	R&S®RTP-K24
1000BASE-T1 Ethernet	R&S®RTP-K87
MultiGBASE-T1 Ethernet (2.5G/5G/10G)	R&S®RTP-K88
<b>PCI Express</b>	
PCIe Express 1.1/2.0	R&S®RTP-K81
PCIe Express 1.1/2.0/3.0	R&S®RTP-K83
<b>MIPI</b>	
MIPI D-PHY	R&S®RTP-K26
<b>HDMI™</b>	
HDMI 1.4/2.0/2.1	R&S®RTP-K110
<b>Memory</b>	
DDR3/DDR3L/LPDDR3	R&S®RTP-K91
DDR4/LPDDR4	R&S®RTP-K93
eMMC (HS200/HS400)	R&S®RTP-K92

Automated PCI Express compliance test



# Frequency domain analysis

## Multichannel frequency analysis

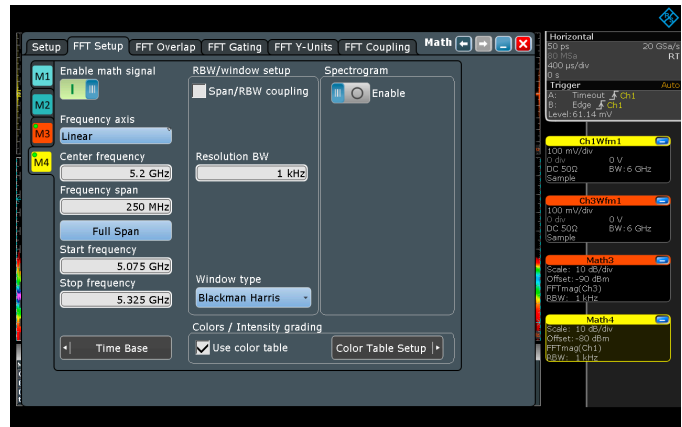
R&S®RTP oscilloscopes feature a fast and responsive FFT on up to four channels in parallel. The low-noise frontend and the A/D converter's high effective number of bits provide an outstanding spurious-free dynamic range, so that even weak signals can be identified.



R&S®RTP multichannel frequency analysis of a WLAN IEEE 802.11n and 11ac MIMO signal

## Frequency analysis setup made easy

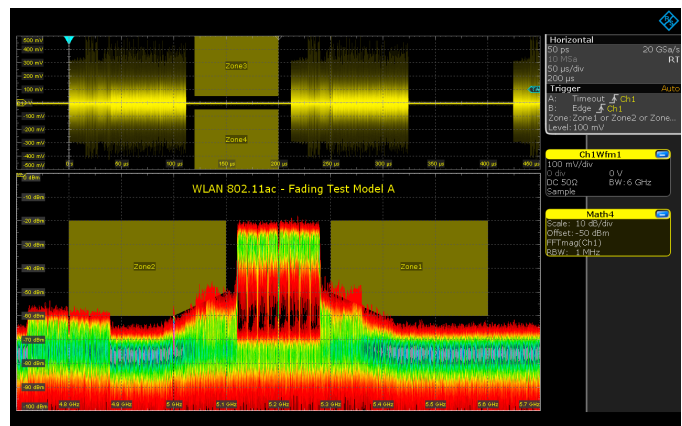
Configure the frequency analysis function of the R&S®RTP by simply entering typical parameters: center frequency, span and resolution bandwidth (RBW). The RBW is independent of the time/div setting. Parameters such as window type, FFT overlap, gating and scaling parameters can be optionally configured.



Setup of frequency analysis made easy with typical parameters

## Zone trigger in frequency display

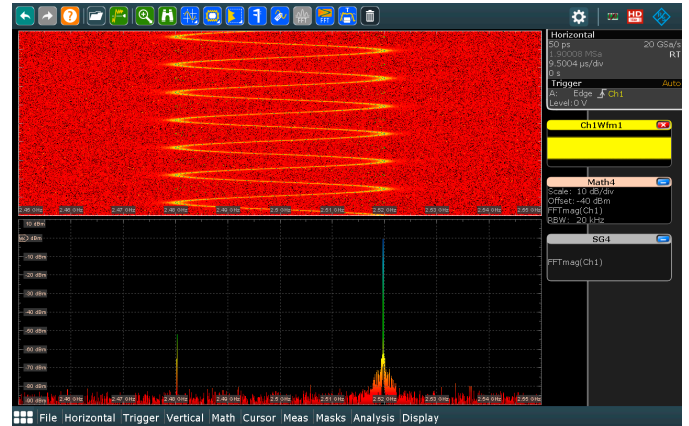
R&S®RTP oscilloscopes offer a zone trigger that works in the frequency domain. Up to eight zones can be graphically defined in the spectrum display and used to trigger the oscilloscope. Typical applications include fast detection and analysis of unwanted emissions, frequency hopping patterns and radar bursts.



Triggering on a WLAN IEEE 802.11ac signal under fading conditions using the zone trigger

### Spectrogram: display changes in power and frequency over time

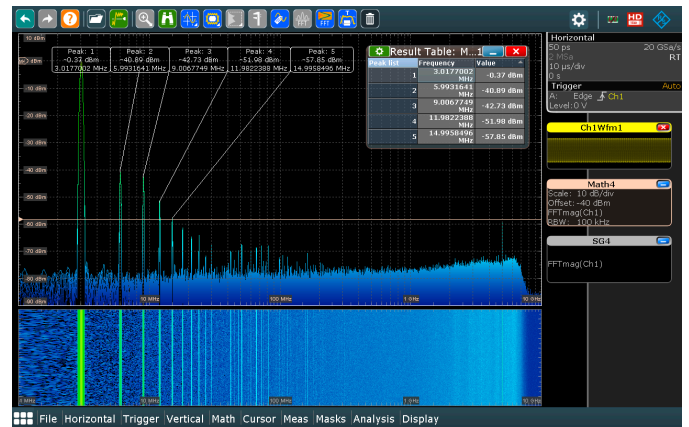
The R&S®RTP-K37 spectrogram option analyzes time-varying signals in the frequency domain. The spectrogram visualizes the variance of power and frequency versus time. This feature allows you to quickly analyze AM/FM modulated signals as well as signals from radar and frequency hopping systems.



Analysis and display of power and frequency variance of an FM modulated signal versus time using the spectrogram display

### Logarithmic display

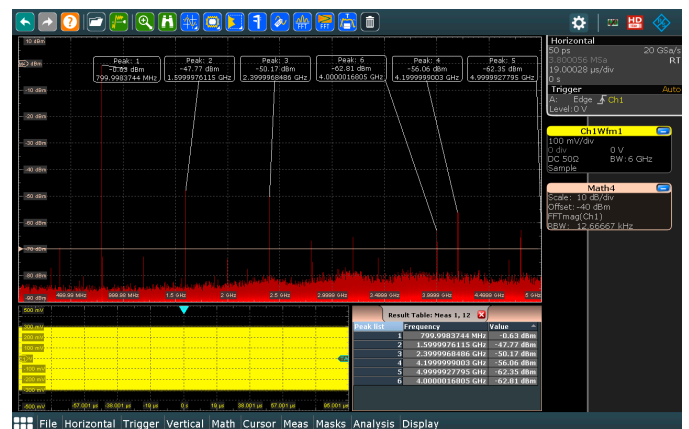
For measurements such as EMI debugging, a logarithmic scaling of the frequency axis is useful to better display values of several orders of magnitude. The R&S®RTP-K37 spectrogram option supports this functionality for the frequency and spectrogram display.



Display of EMI measurement results on a logarithmic y-axis

### Automatic peak list measurement

To analyze a device’s harmonic and intermodulation products, the power and frequency of each peak has to be measured. With the R&S®RTP-K37 option, the peak list measurement is performed automatically. Each peak is measured individually and displayed directly in the measurement graph and optionally in a table. The peaks are marked in the frequency display. Frequency and power information is also displayed.



Analysis of harmonic and intermodulation products with the automatic peak list measurement

# Wideband RF signal analysis

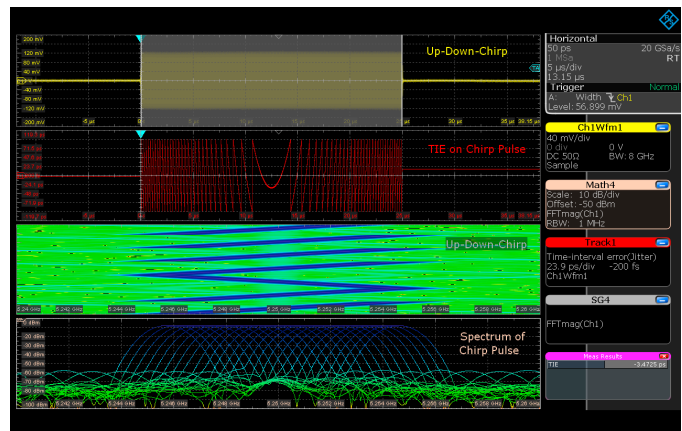
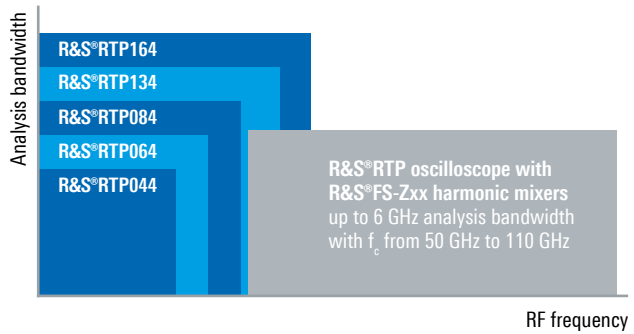
## Precise wideband RF signal analysis

The R&S®RTP lets you perform precise multichannel wideband RF measurements up to 16 GHz. For measurements with an RF carrier frequency between 50 GHz and 110 GHz, combine the R&S®RTP with the R&S®FS-Zxx harmonic mixers to achieve an analysis bandwidth of up to 6 GHz.

The RF characteristic of the R&S®RTP is outstanding. With a sensitivity of  $-157$  dBm (1 Hz) and a dynamic range of 111 dB, the R&S®RTP is qualified to accurately analyze the RF signal.

Generic R&S®RTP oscilloscope functions such as spectrum view, spectrogram and track display of timing measurements in combination with the powerful trigger system allow fast and intuitive analysis of RF signals. To further analyze pulsed and modulated RF signals, combine the R&S®RTP with the R&S®RTP-K11 I/Q interface option and the R&S®VSE vector signal explorer software.

## Rohde & Schwarz wideband RF analysis portfolio

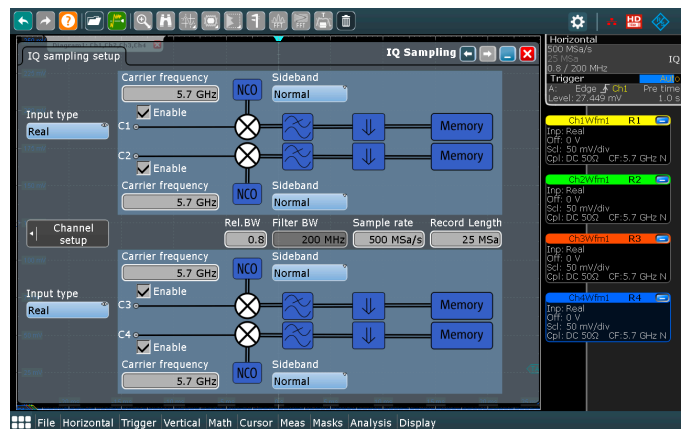


Pulse analysis of up-down chirp in time and frequency domain with generic R&S®RTP oscilloscope functions

## Conversion of modulated signals to I/Q data

The R&S®RTP-K11 I/Q interface significantly simplifies analysis of modulated signals. The option converts modulated signals to I/Q data. This saves acquisition memory and extends the maximum acquisition time.

The I/Q data can be processed with the dedicated R&S®VSE vector signal explorer software or with customized implementations, for example in MATLAB®.



Setup dialog for the R&S®RTP-K11 I/Q interface

## Advanced RF signal analysis

The R&S®VSE vector signal explorer application software analyzes complex signals such as pulsed radar and digitally modulated signals. This software provides a wide range of analysis tools for debugging and optimizing circuit designs. The R&S®VSE offers generic I/Q analysis and analog demodulation capabilities. Additional options such as pulse and transient analysis and powerful vector signal analysis are available. The R&S®VSE software runs directly on the R&S®RTP or alternatively on an external PC.

For users who only need the R&S®VSE installed and running on an R&S®RTP, the oscilloscope-only R&S®VSE-KTxxx options represent a cost-effective alternative solution. These options only run on the device they were purchased for and already include the R&S®VSE core functionality.

## R&S®VSE vector signal explorer software

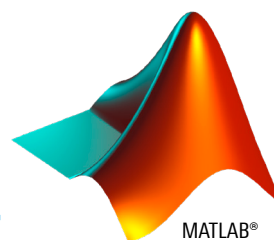
Analysis option R&S®VSE (flexible installation)	Analysis option R&S®VSE (oscilloscope-only)	Typical measurements	Waveform mode	I/Q mode <sup>1)</sup>
R&S®VSE base software I/Q analyzer	core functionality already included in specific options	baseband I/Q analysis	•	•
R&S®VSE-K6	R&S®VSE-KT6	pulse measurements	•	•
R&S®VSE-K6A	R&S®VSE-KT6A	multichannel pulse analysis	•	•
R&S®VSE-K7	R&S®VSE-KT7	AM/FM/PM modulation analysis	•	•
R&S®VSE-K10	R&S®VSE-KT10	GSM measurements		•
R&S®VSE-K18	R&S®VSE-KT18	amplifier measurements	•	•
R&S®VSE-K60	R&S®VSE-KT60	transient measurements	•	•
R&S®VSE-K70	R&S®VSE-KT70	vector signal analysis	•	•
R&S®VSE-K72	R&S®VSE-KT72	3GPP WCDMA uplink and downlink signal analysis, including HSDPA, HSUPA and HSPA+		•
R&S®VSE-K91	R&S®VSE-KT91	WLAN signal analysis, in line with the WLAN IEEE 802.11a/b/g/n/p/ac/ax standard		•
R&S®VSE-K96	R&S®VSE-KT96	analysis of user-defined OFDM and OFDMA signals	•	•
R&S®VSE-K100/-K102/-K104	R&S®VSE-KT100/-K102/-K104	LTE and LTE-Advanced signal analysis		•
R&S®VSE-K106	R&S®VSE-KT106	LTE narrowband IoT analysis		•
R&S®VSE-K144	R&S®VSE-KT144	3GPP 5G NR downlink and uplink measurement application		•
R&S®VSE-K146	R&S®VSE-KT146	3GPP 5G NR downlink MIMO measurements		•
R&S®VSE-K148	R&S®VSE-KT148	3GPP 5G NR Release 16 extension for uplink/downlink		•
R&S®VSE-K149	R&S®VSE-KT149	HRP UWB measurements	•	•
R&S®VSE-K175	R&S®VSE-KT175	O-RAN measurements		•
R&S®VSE-K544	R&S®VSE-KT544	user-defined frequency correction by SnP file	•	•

<sup>1)</sup> R&S®RTP-K11 I/Q software interface required.

## Advanced RF analysis capabilities with the R&S®RTP oscilloscope



R&S®VSE vector signal explorer software



MATLAB®

# MULTI-INSTRUMENT CAPABILITY

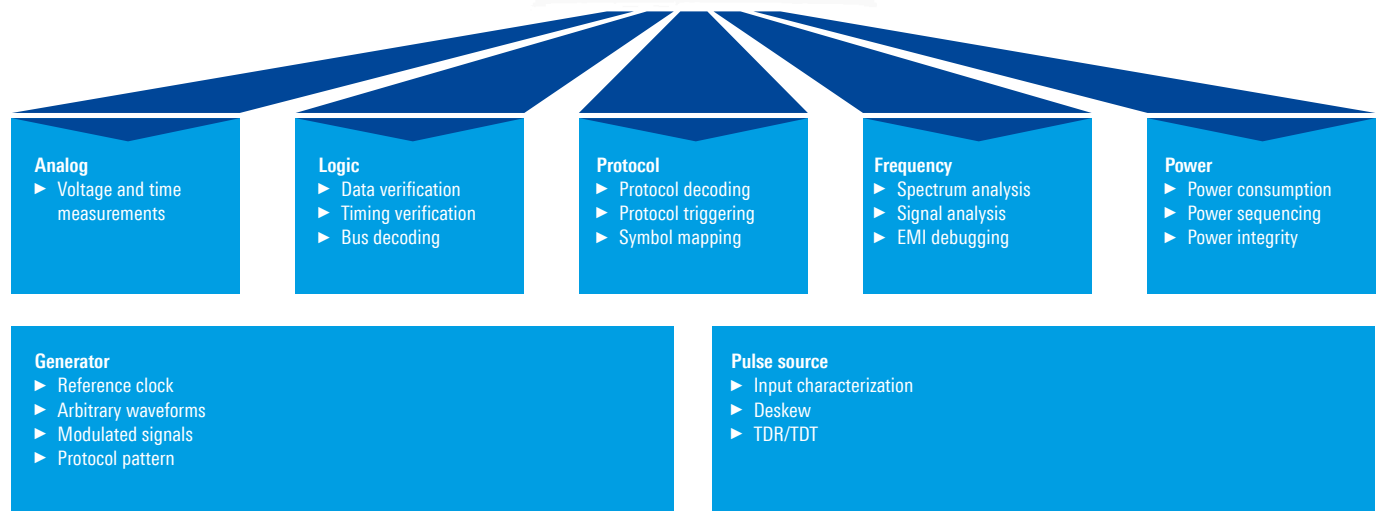
## Time-correlated analysis of multiple signal types

The R&S®RTP oscilloscope addresses today's and tomorrow's test requirements for highly integrated devices. It combines multiple test instrument capabilities in a single box:

- ▶ The high bandwidth **analog channels** offer superior signal fidelity for measurements on fast signals, e.g. high speed buses and wideband RF transmitters
- ▶ General purpose resources, such as the **digital channels** (MSO) or the **arbitrary and pattern generator**, allow logic analysis or protocol based testing of low-speed serial buses. The R&S®RTP features a unique 16 GHz differential pulse source for device stimulus or signal path characterization.
- ▶ The unique **18-bit high-precision voltage and current channels** enable time-correlated analysis of multiple power rails for debugging power consumption and power integrity issues
- ▶ The R&S®RTP provides comprehensive tools for detailed signal analysis in the **frequency domain** on up to four channels in parallel
- ▶ As a unique tool, the R&S®RTP features a **16 GHz differential pulse source** for device stimulus or signal path characterization

All tools are integrated into a single instrument with a consistent interface, turning the R&S®RTP into the most versatile high speed debugging instrument.

## The R&S®RTP oscilloscope: multiple test instruments in one





# SERIAL PROTOCOL ANALYSIS

## Easy configuration

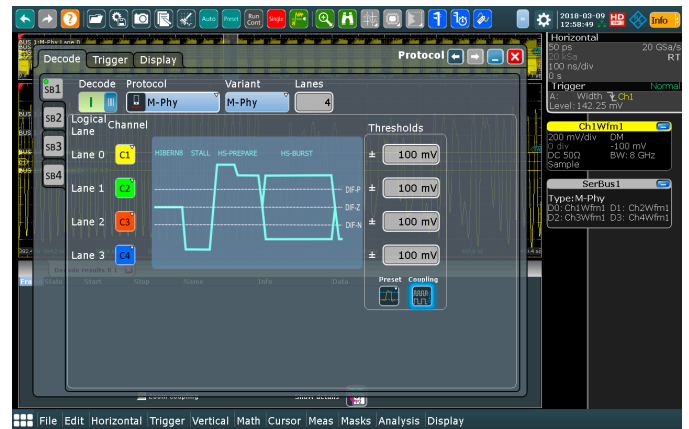
R&S®RTP oscilloscopes offer a broad selection of trigger and decoding options for serial protocol analysis. The configuration for any given protocol is accomplished in just a few steps starting from the app cockpit. Just select the protocol and define the input sources. Autoset functionality supports you wherever possible.



Select from the broad portfolio of serial protocol options

## Isolate protocol events with protocol-specific trigger

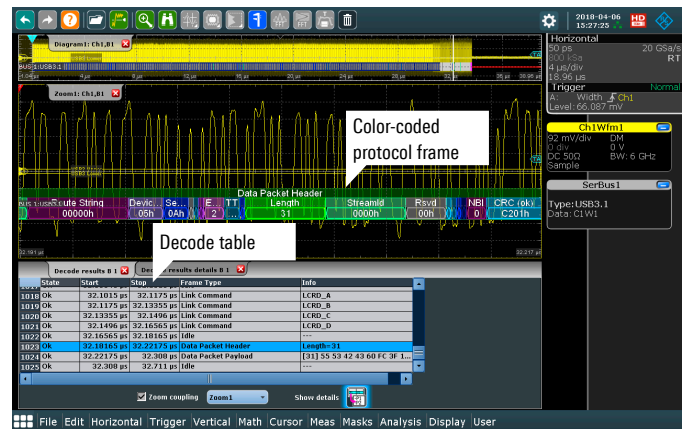
Protocol-specific triggers support fast isolation of protocol related errors. The R&S®RTP offers triggering on specific protocol content, e.g. address and data, as well as on protocol errors.



Configuration of the protocol trigger

## Clear display of decoded data

For easy readability of the decoded data, the individual protocol areas within the logical signals are color-coded. The data formats hex, bin and ASCII can be selected. The R&S®SmartGrid function supports flexible placement of the signals in a suitable diagram. The protocol data can also be displayed in a decode table.



Clear display of decoded data in the waveform and in the decode table

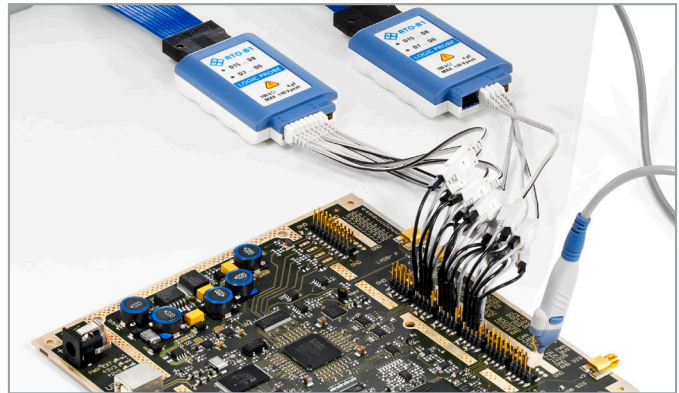
# GENERAL PURPOSE MSO

## Upgrade any R&S®RTP with the mixed signal option

The R&S®RTP-B1 mixed signal option (MSO) adds 16 digital channels to the instrument without compromising other test resources. Thanks to the unique plug&play concept of the R&S®RTP, you can quickly install the hardware option on site without opening the oscilloscope. Simply insert it into an option slot on the front or rear panel. With a sampling rate of 5 Gsample/s, the R&S®RTP-B1 provides high time resolution of 200 ps for all digital channels. This sampling rate is available over the entire memory depth of 200 Msample per channel. The MSO option offers comprehensive trigger capabilities to detect critical events such as narrow glitches or certain pattern combinations.

## R&S®RTP-B1 MSO option

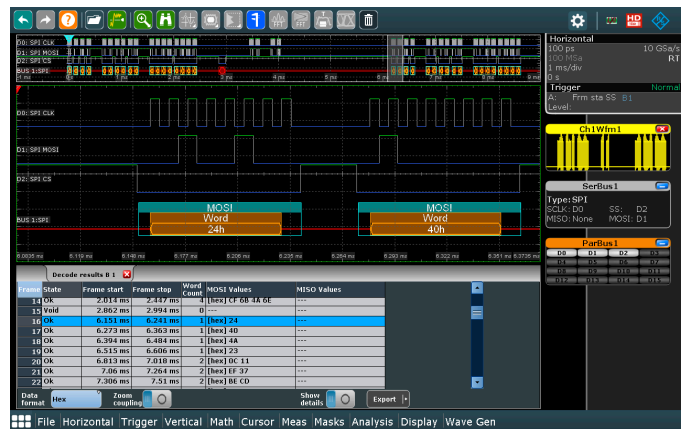
- ▶ 16 digital channels (2 logic probes)
- ▶ 100 k $\Omega$  || 4 pF input impedance
- ▶ 400 MHz signal frequency
- ▶ 5 Gsample/s per channel sampling rate
- ▶ 200 Msample per channel acquisition rate



Every R&S®RTP can be upgraded on site with 16 digital channels

## Analysis of low-speed serial protocols with digital channels

Today, high speed interfaces are often combined with low-speed control or programming buses in a single device. Use the digital channels of the R&S®RTP-B1 option to trigger and decode low-speed serial protocols such as SPI and I<sup>2</sup>C with the appropriate protocol options. All protocol analysis tools for the analog channels, such as decode table and search, are also available for the digital channels. Trigger on protocol details such as start, address and data in order to focus the analysis on dedicated events.



The digital channels are ideal for triggering and decoding low-speed serial interfaces such as SPI

# HIGH-PRECISION VOLTAGE AND CURRENT CHANNELS

## Additional 8 voltage and 8 current channels

The R&S®RTP oscilloscope supports up to two R&S®RT-ZVC multi-channel power probe modules with four current and four voltage channels each. These 16 high-precision measurement channels are usable in parallel with the high speed analog channel of the R&S®RTP.

A key application is time-correlated measurement of a DUT's power consumption during ramp-up, standard operation and sleep mode.

## R&S®RT-ZVC multi-channel power probe module

- ▶ Voltage ranges:  $\pm 1.88$  V,  $\pm 3.75$  V,  $\pm 7.5$  V,  $\pm 15$  V
- ▶ Current ranges: low-gain mode with shunt
  - $\pm 4.5$   $\mu$ A;  $\pm 45$   $\mu$ A with 10 k $\Omega$  shunt
  - $\pm 4.5$  mA;  $\pm 45$  mA with 10  $\Omega$  shunt
  - $\pm 4.5$  A;  $\pm 10$  A with 10 m $\Omega$  shunt
  - $\pm 45$  mV<sup>1)</sup>;  $\pm 450$  mV<sup>1)</sup> with external shunt

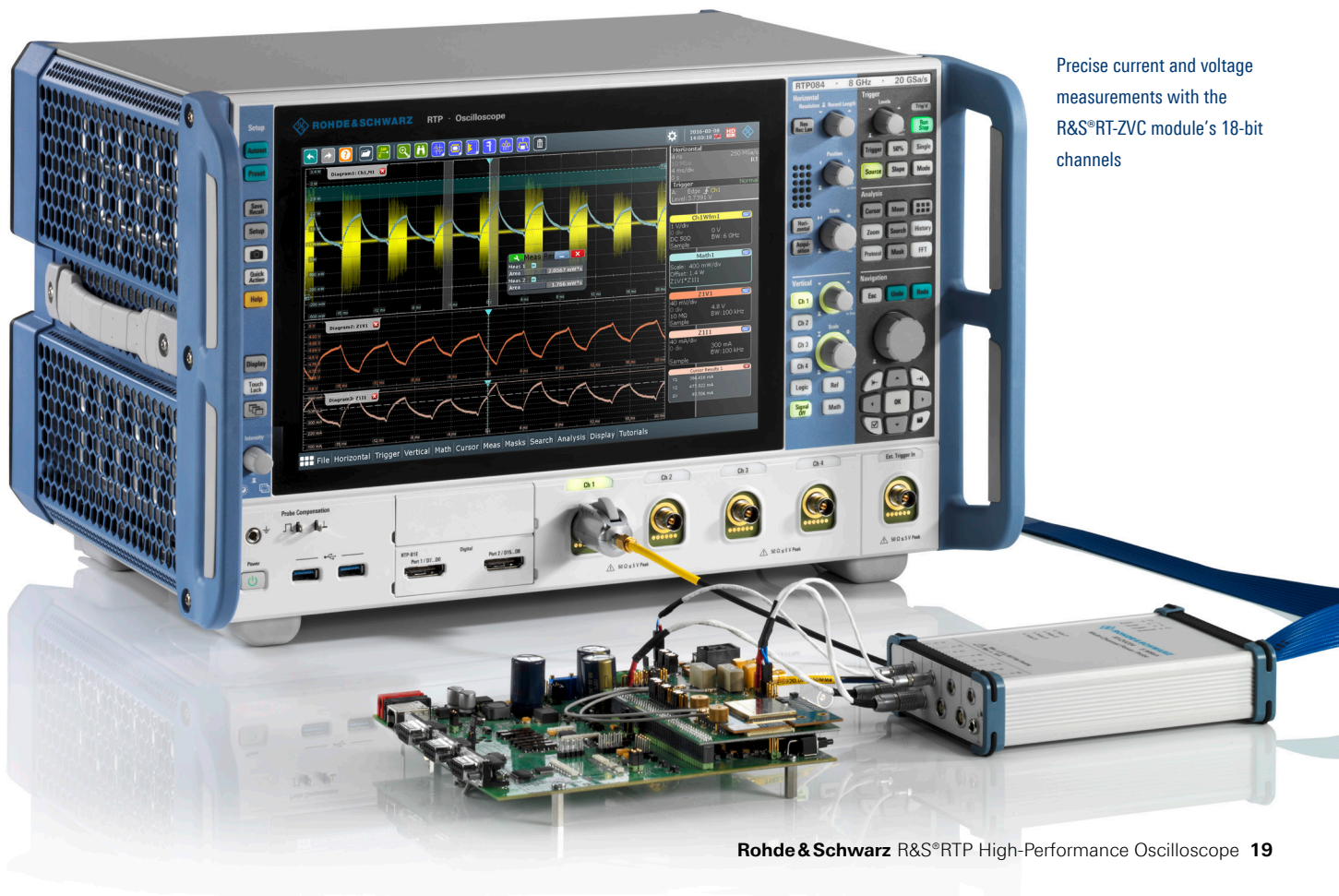
<sup>1)</sup> Current range depends on shunt value.

## Very high dynamic range with 18-bit resolution

Each of the R&S®RT-ZVC channels operates with an 18-bit 5 Msample/s A/D converter and features a high DC accuracy of 0.1% for voltage measurements and 0.2% for current measurements. The high A/D converter resolution provides the right measurement dynamic range to verify current consumption transitions from  $\mu$ A to A as happens when battery-powered devices switch from or into sleep mode. The high DC accuracy is ideal for precisely monitoring the timing and tolerances of power rail voltages of sophisticated embedded devices.

## Full GUI integration

Operation of the R&S®RT-ZVC modules is fully integrated into the R&S®RTP oscilloscope graphical user interface (GUI). The R&S®RT-ZVC channels can be handled like standard oscilloscope channels, including position on the display, vertical scaling and analysis tools like cursors and automated measurements.



Precise current and voltage measurements with the R&S®RT-ZVC module's 18-bit channels

# INTEGRATED ARBITRARY WAVEFORM GENERATOR

## Device stimulus with a two-channel 100 MHz arbitrary waveform generator

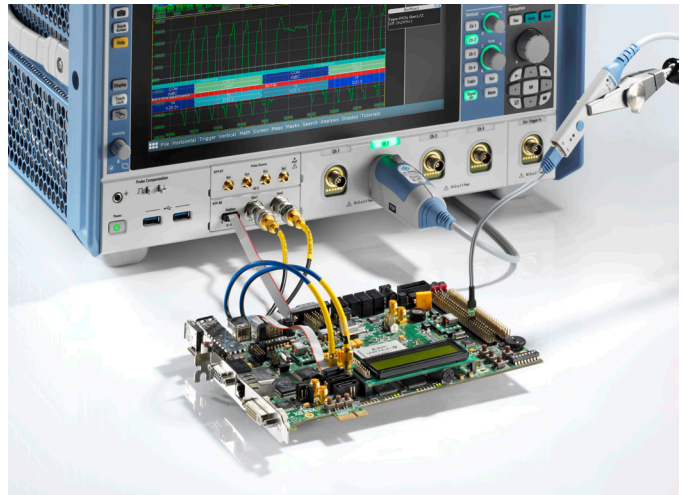
The R&S®RTP oscilloscope offers a fully integrated two-channel 100 MHz function and arbitrary waveform generator, including an eight-channel pattern generator, as a retrofittable hardware option. This integrated generator with 500 Msample/s and 14-bit resolution saves space on the test bench and provides both standard and arbitrary stimulus to the DUT. By combining both generator channels, differential device inputs can also be stimulated. Another powerful feature of the generator is that playback of captured waveforms can be manipulated by changing the amplitude and offset level or be superimposed with noise to evaluate a device against design criteria.

## Protocol based programming with the eight-channel pattern generator

The R&S®RTP-B6 can be used for protocol based programming of devices under test. For instance, an SPI based programming sequence can be used to control the device during the debug and verification process. The generator will control the device and change the configuration while the DUT is being measured with the oscilloscope. This makes it easy to analyze switching effects and timing related parameters.

In addition, for fully automated compliance testing, R&S®ScopeSuite can utilize the integrated R&S®RTP-B6 arbitrary waveform and pattern generator.

Specifications in brief	
Analog output	2 channels
Bandwidth	100 MHz
Sampling rate	500 Msample/s
Resolution	14 bit
Operating modes	<ul style="list-style-type: none"><li>▶ Function generator (sine, square, ramp, DC, pulse, cardinal sine, cardiac, Gauss, Lorentz, exponential rise/fall)</li><li>▶ Modulation generator (AM, FM, FSK)</li><li>▶ Sweep generator</li><li>▶ Arbitrary waveform generator</li></ul>
Pattern generator	8 channels
Memory	40 Msample per channel



Measurement of LVDS signals using the integrated arbitrary waveform generator as the clock signal and the 8-bit pattern generator to program and control the device

# 16 GHz DIFFERENTIAL PULSE SOURCE

## Differential pulse signal with configurable parameters

The R&S®RTP-B7 pulse source provides a highly symmetrical differential pulse signal with a steep rise time of 22 ps.

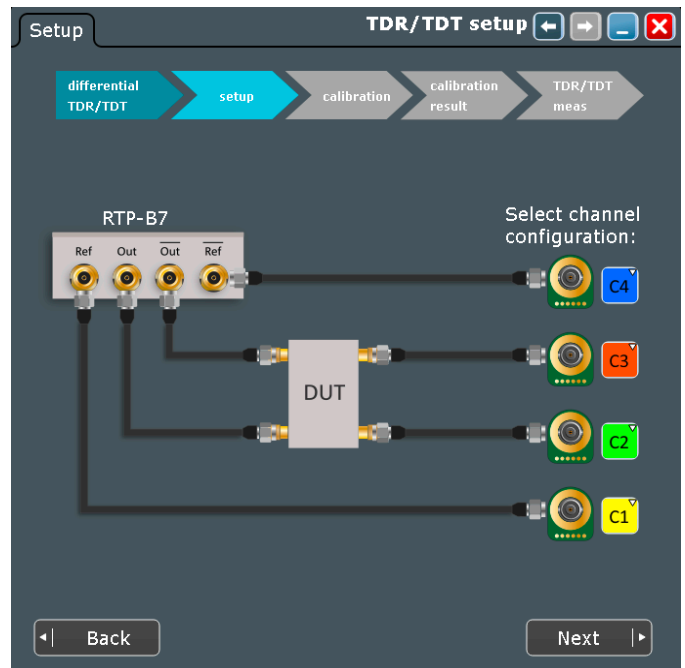
The key parameters of the pulse source are user adjustable. The output level ranges from –50 mV to –200 mV and can be set in 10 mV steps. The pulse repetition rate and the duty cycle are programmable in the range of 5 Hz to 250 MHz and 10% to 90% respectively.

With an output skew of < 0.5 ps, the R&S®RTP-B7 also provides an accurate source for deskewing the measurement setup with multiple channels. Due to its differential nature, the R&S®RTP-B7 is ideal for deskewing cables and probes for differential measurements.

## TDR/TDT analysis

The R&S®RTP-K130 option combines the R&S®RTP-B7 pulse source and the analog input channels of the R&S®RTP oscilloscope to create a time domain reflection (TDR) and transmission (TDT) analysis system that supports the characterization and debugging of signal paths, including PCB traces, cables and connectors. The option allows both single-ended and differential measurements. The TDR/TDT software includes a wizard that guides the user through setup, calibration and analysis. The resulting waveforms can be displayed as impedance or reflection coefficient over time or distance. All oscilloscope analysis tools such as cursor and automated measurements can be used.

Parameter	Value range
Analog bandwidth, rise time	> 16.5 GHz, 22 ps
Skew	< 0.5 ps
Output low level	–200 mV to –50 mV, 10 mV steps
Repetition rate	
Locked	5/10/20/50/100/200/500 Hz, 1/5/10/25/50/100/250 MHz
Free running	5/10/20/50/100/200/500 Hz, 1/5/10/25/50 MHz
Duty cycle	
Repetition rate < 5 MHz	10% to 90%, 10% steps
Repetition rate > 5 MHz	50% (const.)
Clock mode	locked, unlocked/free running



TDR/TDT wizard supports setup, calibration and analysis



Differential test setup with the R&S®RTP-B7 pulse source and the R&S®RTP-K130 TDR/TDT analysis option

# COMPACT AND CONFIGURABLE

## Setting new industry standards with the R&S®RTP

- ▶ Most comprehensive and fastest debugging instrument on the market
- ▶ Outstanding real-time signal integrity
- ▶ Most compact high-performance oscilloscope up to 16 GHz
- ▶ Windows 10 platform

## Expand as your requirements grow

- ▶ 4 option slots to add hardware such as
  - 16-channel, general purpose MSO
  - Multiple high-precision, 18-bit current and voltage channels
  - Arbitrary waveform generator
  - 16 GHz differential pulse source
- ▶ Upgrade path for bandwidth and memory
- ▶ Optional real-time deembedding capabilities
- ▶ Optional high speed serial pattern trigger with up to 16 Gbps hardware CDR

## Industry's most compact and silent high-performance oscilloscope

- ▶ Premium design with high-resolution 12.1" display
- ▶ Compact benchtop instrument
- ▶ Silent operation without annoying fan noise

## Quickly operate the instrument via touchscreen

- ▶ Easily customizable waveform display with R&S®SmartGrid technology
- ▶ Fast access to important tools via the toolbar
- ▶ Fast configuration on the sidebar
- ▶ Touchscreen gesture support
- ▶ Unique color coding

## Use the app cockpit to quickly access applications

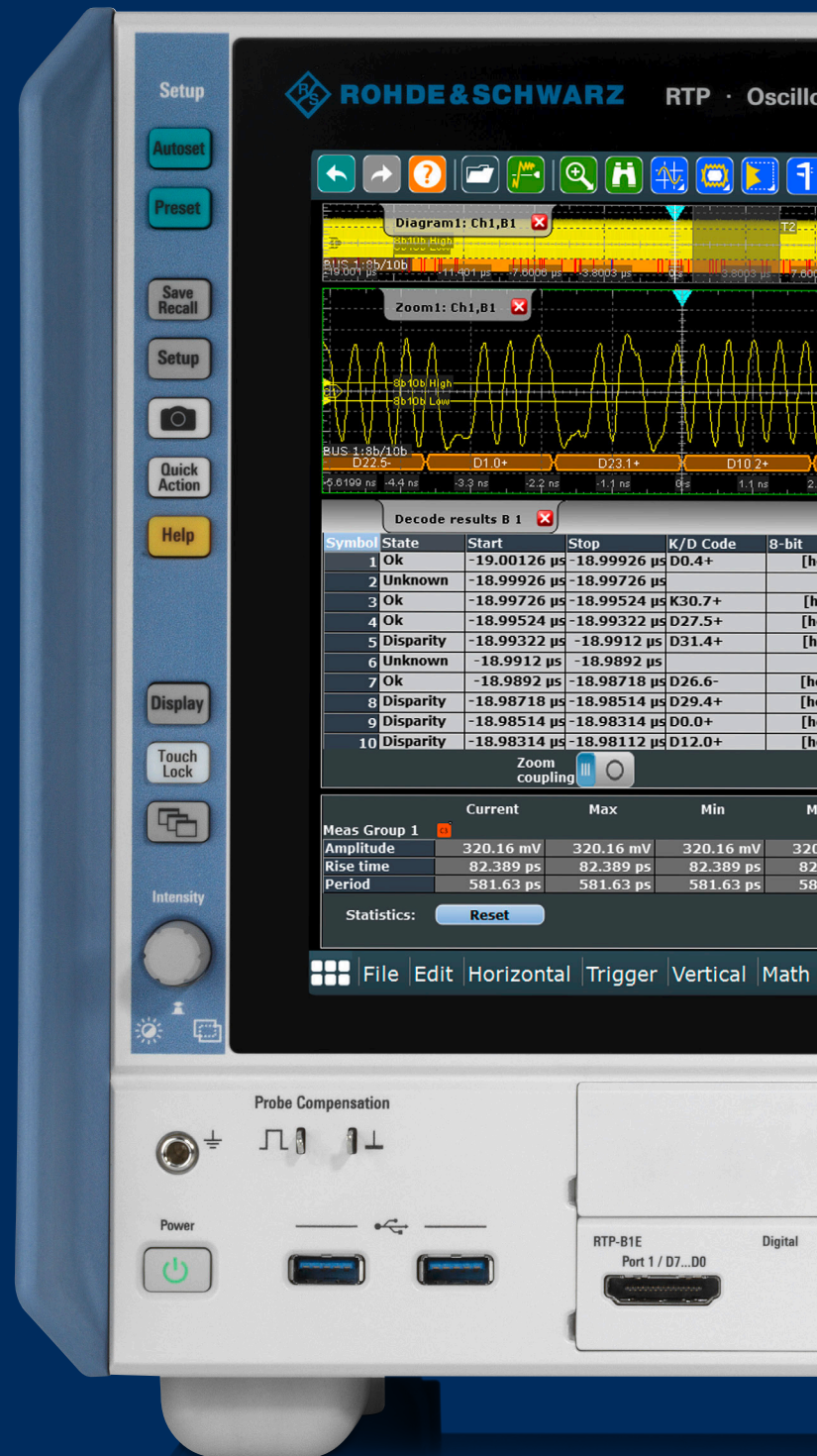
- ▶ Directly access all analysis functions
- ▶ Easily add user applications
- ▶ Decode protocols in seconds

## Versatile connectivity

- ▶ 18 GHz BNC-compatible Rohde & Schwarz probe interface for measurement channels and external trigger
- ▶ Comprehensive probe portfolio

## Interfaces

- ▶ Four USB 3.0 and two USB 2.0 ports
- ▶ USB device port
- ▶ Removable SSD
- ▶ DVI-D and display port
- ▶ LAN connector with 1 Gbps support
- ▶ GPIB IEEE-488 interface





oscope

FFT  FFI

2019-05-31 14:54:46 HD

Diagram3: SG4  
 Diagram2: M4,SG4TL1,SG4TL2

**Horizontal**  
 Resolution: 20 ps  
 Record Length: 1.90014 Msa  
 Position: 3.80028  $\mu$ s/div  
 Trigger: Normal  
 A: Edge Ch1  
 Level: 0 V

**Ch1Wfm1**  
 75 mV/div  
 0 div  
 DC 50  $\Omega$  BW: 16 GHz  
 Sample

**Ch3Wfm1**

**Math4**  
 Scale: 10 dB/div  
 Max: 5 dBm  
 FFTmag(Ch1)  
 RBW: 400 kHz

**SerBus1**  
 Type: 8b/10b  
 Differential: C1W1

**SG4**  
 FFTmag(Ch1)

Mean	RMS	$\sigma$ (S-dev)	Event count	Wave count
0.16 mV	320.16 mV	0 V	1	1
389 ps	82.389 ps	0 s	1	1
1.63 ps	581.63 ps	0 s	1	1

RTP164 · 16 GHz · 40 GSa/s

**Horizontal**  
 Resolution Record Length  
 Res Rec Len  
 Position  
 Scale  
 Acquisition

**Trigger**  
 Levels  
 Trig'd  
 Run Stop  
 Trigger 50% Single  
 Source Slope Mode

**Analysis**  
 Cursor Meas  
 Zoom Search History  
 Protocol Mask FFT

**Vertical**  
 Ch 1  
 Ch 2  
 Ch 3  
 Ch 4  
 Logic Ref  
 Signal Off Math

**Navigation**  
 Esc Undo Redo  
 OK

Ch 1 Ch 2 Ch 3 Ch 4 Ext. Trigger In

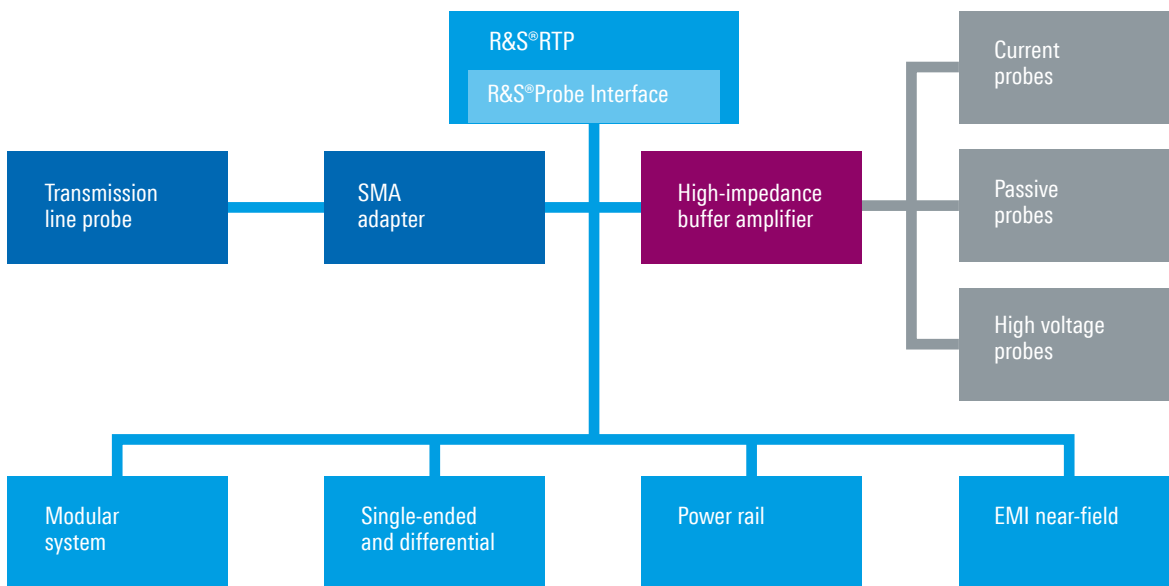
50  $\Omega$   $\leq$  5 V Peak

# COMPREHENSIVE PROBE PORTFOLIO

## Diverse probing options

R&S®RTP oscilloscopes support a broad range of probing solutions to address various measurement requirements. The oscilloscope automatically detects Rohde & Schwarz active probes and corrects the frequency response to obtain a flat characteristic. For applications with a 50 Ω SMA connector, R&S®RTP oscilloscopes come with a high-precision BNC to SMA adapter.

## Diverse probing options



■ Probes which can be directly connected

■ Probes which require R&S®RT-Z1M high-impedance buffer amplifier

## Recommended broadband probes

Oscilloscope	R&S®RTP044	R&S®RTP064	R&S®RTP084	R&S®RTP134	R&S®RTP164
<b>R&amp;S®RT-ZM modular probes</b>					
R&S®RT-ZM160					
R&S®RT-ZM130					
R&S®RT-ZM90					
R&S®RT-ZM60					
<b>R&amp;S®RT-ZZ transmission line probe</b>					
R&S®RT-ZZ80					
<b>R&amp;S®RT-ZS/R&amp;S®RT-ZD single-ended/differential active probes</b>					
R&S®RT-ZS60					
R&S®RT-ZD40					



# VARIETY OF GENERAL PURPOSE PROBES

## Active broadband probes

High input impedance of 1 M $\Omega$ , low input capacitance of < 1 pF and a wide dynamic range are typical characteristics of Rohde & Schwarz active broadband probes. Useful supplemental functions, such as offset compensation in the probe, an integrated, high-precision voltmeter and a micro button for convenient control of the oscilloscope, support users in their daily work.

The Rohde & Schwarz probe interface allows the oscilloscope to automatically detect the probes when they are connected and load the probe type-specific correction factor for a flat frequency response.

The probes are available as single-ended (R&S®RT-ZSxx) and differential (R&S®RT-ZDxx) models. The probe bandwidth ranges from 1 GHz to 6 GHz for R&S®RT-ZSxx probes and 1 GHz to 4.5 GHz for R&S®RT-ZDxx probes.



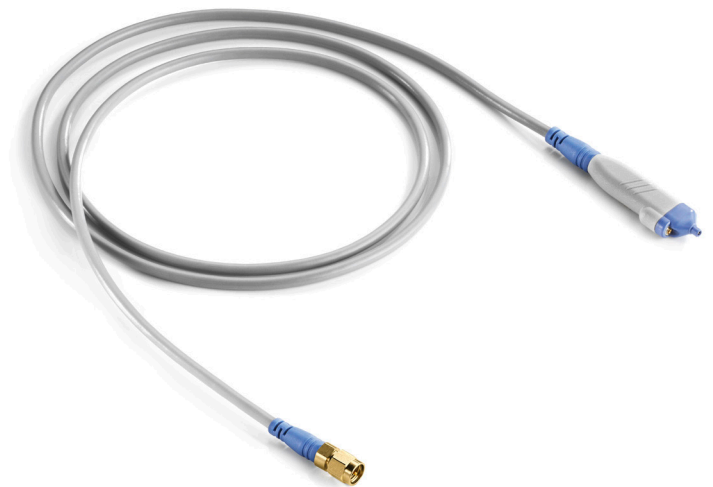
R&S®RT-ZS60

R&S®RT-ZD40

Model	Bandwidth	Attenuation factor	Input impedance	Dynamic range	Offset compensation
R&S®RT-ZS60 single-ended	6 GHz	10:1	1 M $\Omega$    0.3 pF	$\pm 8$ V	$\pm 10$ V
R&S®RT-ZD40 differential	4.5 GHz, typ. 5.5 GHz	10:1	1 M $\Omega$    0.4 pF	$\pm 5$ V	$\pm 5$ V

## R&S®RT-ZZ80 passive broadband probe

Low noise, high linearity and a purely passive implementation make passive broadband probes an economical solution for measuring controlled impedance lines.



Model	Bandwidth	Attenuation factor	Input impedance	Dynamic range	Comment
R&S®RT-ZZ80	8 GHz	10:1	500 $\Omega$    0.3 pF	20 V (RMS) max. input voltage	connect with R&S®RT-ZA16 high-precision SMA adapter

# MODULAR PROBING SOLUTIONS

## Versatile and flexible modular probe system

The R&S®RT-ZM modular probe system addresses today's probing requirements with a technically sophisticated, yet easy-to-handle design. The various probing solutions meet the demands for high probing bandwidth and dynamic range in conjunction with the need for low capacitive load. The R&S®RT-ZM probe system includes probe tip modules for various measurement tasks and conditions. The probe tip modules are connected to the amplifier modules with bandwidths ranging from 1.5 GHz to 16 GHz.

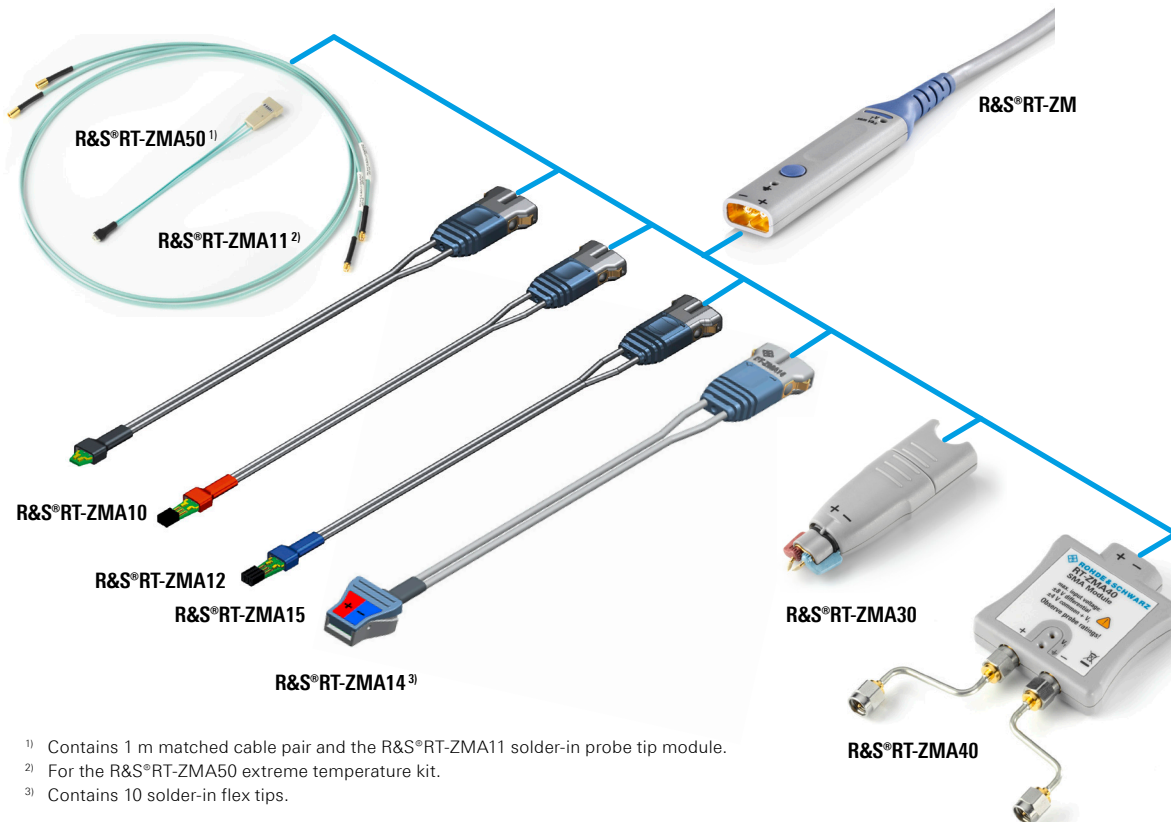
The modular probe system offers multimode functionality and a unique offset compensation range of  $\pm 16$  V at the tip of the probe. In addition, the integrated R&S®ProbeMeter performs high-precision, 18-bit based DC voltage measurements in parallel and independently of the oscilloscope settings.



R&S®RT-ZM amplifier module with the Rohde & Schwarz probe interface

## Probe tip modules for the R&S®RT-ZM

► For detailed information, see R&S®RT-ZM flyer PD 3607.5690.32



<sup>1)</sup> Contains 1 m matched cable pair and the R&S®RT-ZMA11 solder-in probe tip module.

<sup>2)</sup> For the R&S®RT-ZMA50 extreme temperature kit.

<sup>3)</sup> Contains 10 solder-in flex tips.

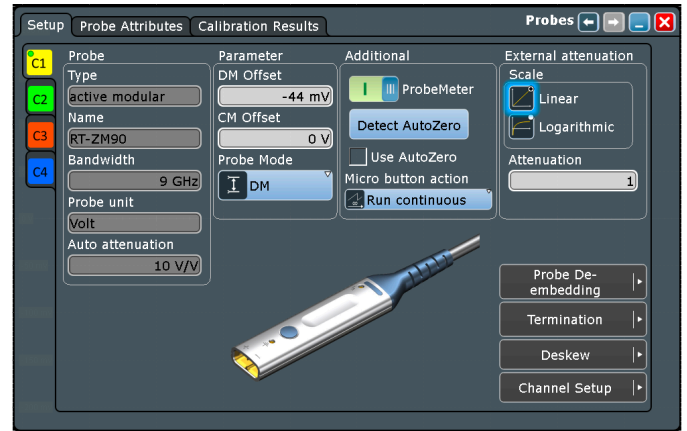
## Multimode: multiple measurements with a single connection

The multimode functionality allows you to switch between single-ended, differential and common mode measurements without reconnecting or resoldering the probe tip.

The multimode functionality is implemented on the company-designed, high speed R&S®RT-ZM amplifier ASIC and is easily controlled from the oscilloscope GUI.

## Offset compensation for maximum resolution

The R&S®RT-ZM modular probe system offers a high offset compensation range of  $\pm 16$  V. The DC components of a measured signal can be compensated at the probe tip in order to extend the operating voltage window beyond the dynamic range of the probe amplifier module. The signal components of interest can then be displayed on the oscilloscope with maximum resolution.



Setup dialog with user-configurable parameters of the modular probe

Model	System bandwidth	Rise time (10% to 90%)	Multimode <sup>1)</sup>	Comment	Order No.
<b>Probe amplifier modules</b>					
R&S®RT-ZM15	> 1.5 GHz	< 230 ps			1800.4700.02
R&S®RT-ZM30	> 3 GHz	< 100 ps			1419.3005.02
R&S®RT-ZM60	> 6 GHz	< 75 ps			1419.3105.02
R&S®RT-ZM90	> 9 GHz	< 50 ps			1419.3205.02
R&S®RT-ZM130	> 13 GHz	< 35 ps			1800.4500.02
R&S®RT-ZM160	16 GHz	< 28 ps			1800.4600.02
<b>Probe tip modules</b>					
R&S®RT-ZMA10	16 GHz (meas.)	28 ps	P/N/DM/CM	length: 15 cm (5.9 in)	1419.4301.02
R&S®RT-ZMA10-6				set of 6 R&S®RT-ZMA10 solder-in probe tip modules	1801.4349.02
R&S®RT-ZMA11	16 GHz (meas.)	28 ps	P/N/DM/CM	length: 15 cm (5.9 in), suitable for R&S®RT-ZMA50	1419.4318.02
R&S®RT-ZMA12	6 GHz (meas.)	75 ps	P/N/DM/CM	length: 15 cm (5.9 in)	1419.4324.02
R&S®RT-ZMA14	16 GHz (meas.)	28 ps	P/N/DM/CM	length: 15 cm (5.9 in), incl. 10 solder-in flex tips	1338.1010.02
R&S®RT-ZMA15	12 GHz (meas.)	37 ps	P/N/DM/CM	length: 15 cm (5.9 in)	1419.4224.02
R&S®RT-ZMA30	16 GHz (meas.)	28 ps	DM		1419.4353.02
R&S®RT-ZMA40	16 GHz (meas.)	28 ps	P/N/DM/CM	50 Ω/100 Ω, suitable for SMA, 3.5 mm and 2.92 mm systems, termination voltage $\pm 4$ V, supplied from R&S®RT-ZM probe amplifier module	1419.4201.02
R&S®RT-ZMA50	12 GHz (meas.)	37 ps	P/N/DM/CM	cable length: 1 m (39.37 in); consists of R&S®RT-ZMA11 and a pair of matched extension cables, temperature range: $-55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	1419.4218.02
<b>Accessories</b>					
R&S®RT-ZMA1				for up to 6 R&S®RT-ZMAxx probe tip modules	1419.3928.02
R&S®RT-ZAP				3D probe positioner	1326.3641.02
R&S®RT-ZF30				test fixture for probe characterization with R&S®RTP-B7	1333.2099.02

<sup>1)</sup> Multimode:

DM: differential measurement, CM: common mode measurement, P: single-ended measurement on positive pin, N: single-ended measurement on negative pin.

# POWER INTEGRITY PROBES

## Power rail characterization

High bandwidth, high sensitivity, very low noise and an extra-large offset compensation make the R&S®RT-ZPR an excellent probe for characterizing power rails. With a bandwidth of up to 4 GHz, excellent sensitivity due to the 1:1 attenuation ratio and low noise, the R&S®RT-ZPR40 excels at precise ripple measurements. Coupled with the oscilloscope's powerful frequency analysis capabilities, the R&S®RT-ZPR probes can be used to isolate periodic and random disturbances (PARD). An integrated high-precision, 18-bit DC voltmeter provides an instantaneous DC voltage readout in parallel.



## Measuring small voltages riding on large DC offsets

With the  $\pm 60$  V offset compensation range, the R&S®RT-ZPR power rail probes allow you to focus on small ripples on the power rail's DC voltage. Whether you need to zoom in on a 1 V or much higher DC level, the probe provides the required offset while maintaining lowest vertical resolution.



The high bandwidth of the R&S®RT-ZPR power rail probes allows you to capture high-frequency noise components

## R&S®ProbeMeter: integrated high-precision DC voltmeter

The R&S®RT-ZPR power rail probe incorporates a high-precision DC voltmeter to accurately measure the DC level of a power rail. The integrated 18-bit DC voltmeter with an input voltage range of  $\pm 60$  V easily and accurately monitors long-term drift of the DC level.



Accurately verify DC level and power supply load response during initialization of a DDR memory with the R&S®RT-ZPR power rail probe and its integrated high-precision R&S®ProbeMeter

Model	Bandwidth	Attenuation factor	Input impedance	Dynamic range	Comment	Order No.
R&S®RT-ZPR40	4.0 GHz	1:1	50 k $\Omega$	$\pm 0.85$ V ( $\pm 60$ V offset compensation), optional AC coupling	R&S®ProbeMeter	1800.5406.02

# CONNECTIVITY

## High impedance requirements

To extend the functionality of the R&S®RTP oscilloscope and make use of probes that require a high impedance input, the R&S®RT-Z1M high-impedance buffer amplifier can be used. It allows you to connect probes such as standard passive and high voltage probes as well as current probes to the oscilloscope.

The integrated R&S®ProbeMeter additionally supports high-precision DC voltage measurements with 0.01% measurement accuracy.



Model	Bandwidth	Input impedance	Offset range	Input coupling	Comment	Order No.
R&S®RT-Z1M	500 MHz	1 MΩ ± 1%    12 pF	±60 V (max.)	DC, AC, GND	R&S®ProbeMeter	1337.9200.02

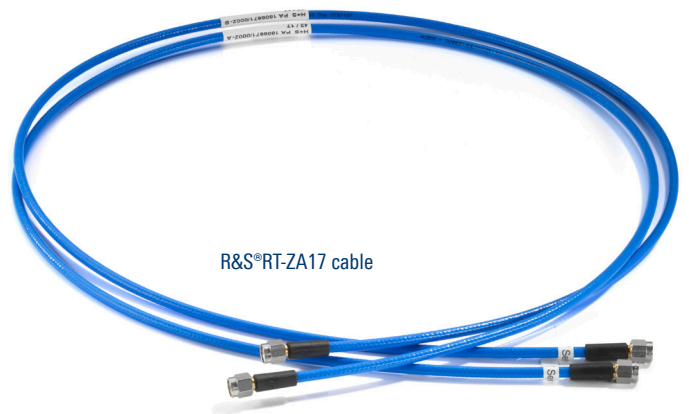
## Connectivity

R&S®RTP oscilloscopes come with two R&S®RT-ZA16 precision BNC to SMA adapters. The adapter enables a coaxial SMA connection to the R&S®RTP oscilloscope's 18 GHz BNC-compatible probe interface.



R&S®RT-ZA16 precision BNC to SMA adapter

A low-loss and phase-matched cable pair with a length of 1 m (R&S®RT-ZA17) is available for high-precision measurements. The cables are configured with 3.5 mm male connectors on both sides. The specified skew error between the matched cables is below 5 ps.



R&S®RT-ZA17 cable

R&S®RT-ZA17 specification in brief	
Cable length	1 m
Connectors	3.5 mm (m) to 3.5 mm (m)
Frequency	26.5 GHz
Skew error	< 5 ps
Matching	> 15 dB

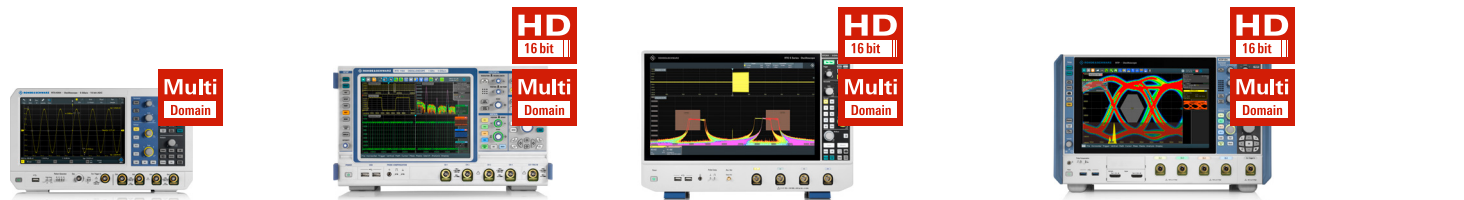
# OSCILLOSCOPE PORTFOLIO



R&S®	RTH1000	RTC1000	RTB2000	RTM3000
<b>Vertical</b>				
Bandwidth	60/100/200/350/500 MHz <sup>1)</sup>	50/70/100/200/300 MHz <sup>1)</sup>	70/100/200/300 MHz <sup>1)</sup>	100/200/350/500 MHz/1 GHz <sup>1)</sup>
Number of channels	2 plus DMM/4	2	2/4	2/4
Resolution	10 bit	8 bit	10 bit	10 bit
V/div 1 MΩ	2 mV to 100 V	1 mV to 10 V	1 mV to 5 V	500 μV to 10 V
V/div 50 Ω	–			500 μV to 1 V
<b>Horizontal</b>				
Sampling rate per channel (in Gsample/s)	1.25 (4-channel model); 2.5 (2-channel model); 5 (all channels interleaved)	1; 2 (2 channels interleaved)	1.25; 2.5 (2 channels interleaved)	2.5; 5 (2 channels interleaved)
Maximum memory (per channel/1 channel active)	125 ksample (4-channel model); 250 ksample (2-channel model); 500 ksample (50 Msample in segmented memory mode)	1 Msample; 2 Msample	10 Msample; 20 Msample (320 Msample in segmented memory mode <sup>2)</sup> )	40 Msample; 80 Msample (400 Msample in segmented memory mode <sup>2)</sup> )
Segmented memory	standard	–	option	option
Acquisition rate (in waveforms/s)	50 000	10 000	50 000 (300 000 in fast segmented memory mode <sup>2)</sup> )	64 000 (2 000 000 in fast segmented memory mode <sup>2)</sup> )
<b>Trigger</b>				
Options	advanced, digital trigger (14 trigger types) <sup>2)</sup>	elementary (5 trigger types)	comprehensive (7 trigger types)	comprehensive (10 trigger types)
<b>Mixed signal option</b>				
Number of digital channels <sup>1)</sup>	8	8	16	16
Sampling rate of digital channels (in Gsample/s)	1.25	1	1.25	two logic probes: 2.5 on each channel; one logic probe: 5 on each channel
Memory of digital channels	125 ksample	1 Msample	10 Msample	two logic probes: 40 Msample per channel; one logic probe: 80 Msample per channel
<b>Analysis</b>				
Cursor meas. types	4	13	4	4
Standard meas. functions	37	31	32	32
Mask test	elementary (tolerance mask around the signal)	elementary (tolerance mask around the signal)	elementary (tolerance mask around the signal)	elementary (tolerance mask around the signal)
Mathematics	elementary	elementary	basic (math on math)	basic (math on math)
Serial protocols triggering and decoding <sup>1)</sup>	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, CAN-FD, SENT	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, I <sup>2</sup> S, MIL-STD-1553, ARINC 429
Display functions	data logger	–	–	–
Applications <sup>1), 2)</sup>	high-resolution frequency counter, advanced spectrum analysis, harmonics analysis, user scripting	digital voltmeter (DVM), component tester, fast Fourier transform (FFT)	digital voltmeter (DVM), fast Fourier transform (FFT), frequency response analysis	power, digital voltmeter (DVM), spectrum analysis and spectrogram, frequency response analysis
Compliance testing <sup>1), 2)</sup>	–	–	–	–
<b>Display and operation</b>				
Size and resolution	7", color, 800 × 480 pixel	6.5", color, 640 × 480 pixel	10.1", color, 1280 × 800 pixel	10.1", color, 1280 × 800 pixel
Operation	optimized for touchscreen operation, parallel button operation	optimized for fast button operation	optimized for touchscreen operation, parallel button operation	
<b>General data</b>				
Dimensions in mm (W × H × D)	201 × 293 × 74	285 × 175 × 140	390 × 220 × 152	390 × 220 × 152
Weight in kg	2.4	1.7	2.5	3.3
Battery	lithium-ion, > 4 h	–	–	–

<sup>1)</sup> Upgradeable.

<sup>2)</sup> Requires an option.



RTA4000	RTE1000	RT06	RTP
200/350/500 MHz/1 GHz <sup>1)</sup>	200/350/500 MHz/1/1.5/2 GHz <sup>1)</sup>	600 MHz/1/2/3/4/6 GHz <sup>1)</sup>	4/6/8/13/16 GHz <sup>1)</sup>
4	2/4	4	4
10 bit	16 bit system architecture	16 bit system architecture	16 bit system architecture
500 µV to 10 V	500 µV to 10 V	1 mV to 10 V (HD mode: 500 µV to 10 V)	
500 µV to 1 V	500 µV to 1 V	1 mV to 1 V (HD mode: 500 µV to 1 V)	2 mV to 1 V (HD mode: 1 mV to 1 V)
2.5; 5 (2 channels interleaved)	5	10; 20 (2 channels interleaved in 4 GHz and 6 GHz model)	20; 40 (2 channels interleaved)
100 Msample; 200 Msample (1 Gsample in segmented memory mode)	50 Msample/200 Msample	standard: 200 Msample/800 Msample; max. upgrade: 1 Gsample/2 Gsample	standard: 50 Msample/200 Msample; max. upgrade: 1 Gsample/2 Gsample
standard	standard	standard	standard
64 000 (2 000 000 in fast segmented memory mode)	1 000 000 (1 600 000 in ultra-segmented memory mode)	1 000 000 (2 500 000 in ultra-segmented memory mode)	750 000 (3 200 000 in ultra-segmented memory mode)
comprehensive (10 trigger types)	advanced, digital trigger (13 trigger types)	advanced (includes zone trigger), digital trigger (14 trigger types)	advanced, digital trigger (14 trigger types) with real-time deembedding <sup>2)</sup> , high speed serial pattern trigger incl. 8/16 Gbps CDR <sup>2)</sup> , zone trigger <sup>2)</sup>
16	16	16	16
two logic probes: 2.5 on each channel; one logic probe: 5 on each channel	5	5	5
two logic probes: 100 Msample per channel; one logic probe: 200 Msample per channel	100 Msample	200 Msample	200 Msample
4	3	3	3
32	47	47	47
elementary (tolerance mask around the signal)	advanced (user-configurable, hardware based)	advanced (user-configurable, hardware based)	advanced (user-configurable, hardware based)
basic (math on math)	advanced (formula editor)	advanced (formula editor)	advanced (formula editor)
I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, I <sup>2</sup> S, MIL-STD-1553, ARINC 429	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, I <sup>2</sup> S, MIL-STD-1553, ARINC 429, FlexRay™, CAN-FD, USB 2.0/HSIC, Ethernet, Manchester, NRZ, SENT, SpaceWire, CXPI, USB Power Delivery, automotive Ethernet 100BASE-T1	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, I <sup>2</sup> S, MIL-STD-1553, ARINC 429, FlexRay™, CAN-FD, MIPI RFFE, USB 2.0/HSIC, MDIO, 8b10b, Ethernet, Manchester, NRZ, SENT, MIPI D-PHY, SpaceWire, MIPI M-PHY/UniPro, CXPI, USB 3.1 Gen1, USB-SSIC, PCIe 1.1/2.0, USB Power Delivery, automotive Ethernet 100BASE-T1/1000BASE-T1	I <sup>2</sup> C, SPI, UART/RS-232/RS-422/RS-485, CAN, LIN, MIL-STD-1553, ARINC 429, CAN-FD, MIPI RFFE, USB 2.0/HSIC, MDIO, 8b10b, Ethernet, Manchester, NRZ, MIPI D-PHY, SpaceWire, MIPI M-PHY/UniPro, USB 3.1 Gen1/Gen2, USB-SSIC, PCIe 1.1/2.0/3.0, USB Power Delivery, automotive Ethernet 100BASE-T1/1000BASE-T1
–	histogram, trend, track <sup>2)</sup>	histogram, trend, track <sup>2)</sup>	histogram, trend, track
power, digital voltmeter (DVM), spectrum analysis and spectrogram, frequency response analysis	power, 16 bit high definition mode (standard), advanced spectrum analysis and spectrogram	power, 16 bit high definition mode (standard), advanced spectrum analysis and spectrogram, jitter and noise decomposition, clock data recovery, I/Q data, RF analysis, deembedding, TDR/TDT analysis	16 bit high definition mode, advanced spectrum analysis and spectrogram, jitter and noise decomposition, RF analysis, real-time deembedding, TDR/TDT analysis, I/Q data, HS serial pattern trigger with 8/16 Gbps CDR
–	–	various options available (see PD 5216.1640.22)	various options available (see PD 5215.4152.22)
10.1", color, 1280 × 800 pixel	10.4", color, 1024 × 768 pixel	15.6", color, 1920 × 1080 pixel	12.1", color, 1280 × 800 pixel
optimized for touchscreen operation, parallel button operation			
390 × 220 × 152	427 × 249 × 204	450 × 315 × 204	441 × 285 × 316
3.3	8.6	10.7	18
–	–	–	–

# SPECIFICATIONS IN BRIEF

## Specifications in brief

### Vertical system

Number of channels		4
Analog bandwidth (-3 dB)	R&S®RTP044	4 GHz
	R&S®RTP064	6 GHz
	R&S®RTP084	8 GHz
	R&S®RTP134	13 GHz (2 channels interleaved)
	R&S®RTP164	16 GHz (2 channels interleaved)
Impedance		50 Ω
Input sensitivity	max. bandwidth in all ranges	50 Ω: 2 mV/div to 1 V/div
Offset range	> 100 mV/div	±5 V
	≤ 100 mV/div	±(1.5 V – input sensitivity × 5 div)
Resolution		8 bit, up to 16 bit in HD mode

### Acquisition system

Real-time sampling rate	R&S®RTP044/064/084/134/164	40 Gsample/s (2 channels interleaved) 20 Gsample/s on each channel
Acquisition memory	standard configuration	50 Msample on 4 channels; 200 Msample on 1 channel
	max. upgrade (R&S®RTP-B110 option)	1 Gsample on 4 channels; 2 Gsample on 2 channels
Max. acquisition rate	continuous acquisition and display, 40 Gsample/s, 1 ksample	> 750 000 waveforms/s
Deembedding (optional)		real-time deembedding of signal path characteristics based on S-parameters

### Horizontal system

Timebase range		20 ps/div to 10 000 s/div
Accuracy	OCXO as standard, after delivery/calibration	±0.01 ppm
	during calibration interval	±0.1 ppm

### Trigger system

Trigger types	all trigger types up to full bandwidth; based on real-time deembedding (optional)	edge, glitch, width, runt, window, timeout, interval, slew rate, data2clock, pattern, state, TV/video, serial protocol triggers (optional), zone trigger (optional), high speed serial pattern with 16 Gbps CDR (optional)
Zone trigger (optional)		logical combination of max. 8 polygons; intersect or not intersect source: measurement channels, spectrum, math functions
Sensitivity	definition of trigger hysteresis	automatic or manually adjustable from 0 div to 5 div

### General data

Dimensions	W × H × D	441 mm × 285 mm × 316 mm (17.36 in × 11.22 in × 12.44 in)
Weight		18 kg (39.68 lb)
Screen		12.1" LC TFT capacitive color touchscreen, 1280 × 800 pixel (WXGA)
Option slots	2 slots on front side, 2 slots on rear side for upgrading with various hardware options	MSO (16 channels, 400 MHz), R&S®RT-ZVC (multiple high-precision voltage and current channels), arbitrary waveform generator, 16 GHz differential pulse source
Interfaces		1 Gbps LAN, type A: 4 × USB 3.1, 2 × USB 2.0, type B: 1 × USB 3.1, GPIB (standard), DVI and display port for external monitor, external trigger with active probe interface, trigger output, ref in: 1 MHz to 20 MHz, ref out: 10 MHz



# ORDERING INFORMATION

Step 1: choose needed bandwidth and channels	
	<b>4 channels</b>
4 GHz	R&S®RTP044
6 GHz	R&S®RTP064
8 GHz	R&S®RTP084
13 GHz	R&S®RTP134
16 GHz	R&S®RTP164

Step 2: choose additional test resources	
16 digital channels	R&S®RTP-B1
Arbitrary waveform generator	R&S®RTP-B6
16 GHz differential pulse source	R&S®RTP-B7
Multi-channel power probe (4 + 4 channels V/I)	R&S®RTP-ZVC04

Step 3: choose software options			
Technology	Triggering and decoding	Compliance	Test fixture set
Trigger and decode bundle	R&S®RTP-TDBNDL (incl. R&S®RTP-K1/K2/-K3/ -K6/-K7/-K8/-K9/-K50/-K52/ -K55/-K65)		
Embedded			
I <sup>2</sup> C/SPI	R&S®RTP-K1		
UART/RS-232/422/485	R&S®RTP-K2		
10/100 Mbit Ethernet	R&S®RTP-K8	R&S®RTP-K22	R&S®RT-ZF2
1 Gbit Ethernet		R&S®RTP-K22	R&S®RT-ZF2, R&S®RT-ZF2C
2.5G/5GBASE-T Ethernet		R&S®RTP-K25	R&S®RT-ZF2
10 Gbit Ethernet		R&S®RTP-K23	R&S®RT-ZF2
10M/100M/1GBASE-T Energy Efficient Ethernet		R&S®RTP-K86	R&S®RT-ZF4, R&S®RT-ZF5
8b10b	R&S®RTP-K52		
MDIO	R&S®RTP-K55		
USB 1.0/1.1/2.0/HSIC	R&S®RTP-K60	R&S®RTP-K21	R&S®RT-ZF1
USB-PD	R&S®RTP-K63		
USB-SSIC	R&S®RTP-K64		
USB 3.1 Gen 1	R&S®RTP-K61	R&S®RTP-K101	<sup>1)</sup>
USB 3.1 Gen 2	R&S®RTP-K62	R&S®RTP-K101 <sup>2)</sup>	<sup>1)</sup>
PCI Express Gen 1/2	R&S®RTP-K72	R&S®RTP-K81	<sup>3)</sup>
PCI Express Gen 3	R&S®RTP-K73	R&S®RTP-K83 <sup>2)</sup>	<sup>3)</sup>
DDR3		R&S®RTP-K91	<sup>4)</sup>
DDR4		R&S®RTP-K93	<sup>4)</sup>
eMMC (HS200/HS400)		R&S®RTP-K92	
HDMI 1.4/2.0/2.1		R&S®RTP-K110	<sup>5)</sup>
Automotive			
CAN/LIN	R&S®RTP-K3		
CAN-FD	R&S®RTP-K9		
10BASE-T1S Ethernet		R&S®RTP-K89	R&S®RT-ZF7A, R&S®RT-ZF8
10BASE-T1L Ethernet		R&S®RTP-K89	R&S®RT-ZF7P, R&S®RT-ZF7A, R&S®RT-ZF8
100BASE-T1/BroadR-Reach® Ethernet	R&S®RTP-K57	R&S®RTP-K24	R&S®RT-ZF3, R&S®RT-ZF7, R&S®RT-ZF7A, R&S®RT-ZF8
1000BASE-T1 Ethernet	R&S®RTP-K58	R&S®RTP-K87	R&S®RT-ZF6, R&S®RT-ZF7A, R&S®RT-ZF8
MultiGBASE-T1 Ethernet (2.5G/5G/10G)		R&S®RTP-K88	R&S®RT-ZF7A, R&S®RT-ZF8
Aerospace			
MIL-STD-1553	R&S®RTP-K6		
ARINC 429	R&S®RTP-K7		

<sup>1)</sup> USB.org test fixtures: order from [www.usb.org/estore](http://www.usb.org/estore)

<sup>2)</sup> Lower standards are supported.

<sup>3)</sup> PCI-SIG CCB/CLB: order from [www.pcisig.com](http://www.pcisig.com)

<sup>4)</sup> DDR3/DDR4 interposer: order from <http://www.nexustech.com>

<sup>5)</sup> HDMI test fixture: order from [www.wilder-tech.com/en/products/hdmi](http://www.wilder-tech.com/en/products/hdmi)

### Step 3: choose software options

SpaceWire	R&S®RTP-K65		
Mobile communications			
MIPI RFFE	R&S®RTP-K40		
MIPI D-PHY	R&S®RTP-K42	R&S®RTP-K26	
MIPI M-PHY	R&S®RTP-K44		
Configurable			
Manchester, NRZ	R&S®RTP-K50		
Bus analysis	R&S®RTP-K35		

### Step 3: choose software options

#### Analysis

Signal integrity bundle	R&S®RTP-SIBNDL (incl. R&S®RTP-K12/-K19/-K121/-K122/-K141)
Deembedding	R&S®RTP-K121
Deembedding, real-time extension	R&S®RTP-K122
High speed serial pattern trigger (8 Gbps CDR)	R&S®RTP-K140
High speed serial pattern trigger (16 Gbps CDR)	R&S®RTP-K141
Jitter analysis	R&S®RTP-K12
Jitter decomposition	R&S®RTP-K133
Jitter and noise decomposition	R&S®RTP-K134
Spectrogram	R&S®RTP-K37
TDR/TDT analysis	R&S®RTP-K130
Zone trigger	R&S®RTP-K19

#### RF signal analysis

I/Q software interface	R&S®RTP-K11	
<b>Vector signal explorer software</b>	<b>Flexible installation<sup>6)</sup></b>	<b>Oscilloscope-only<sup>7)</sup></b>
License dongle	R&S®FSPC	–
Pulse measurements	R&S®VSE-K6	R&S®VSE-KT6
Multichannel pulse analysis	R&S®VSE-K6A	R&S®VSE-KT6A
AM/FM/PM modulation analysis	R&S®VSE-K7	R&S®VSE-KT7
GSM measurements	R&S®VSE-K10	R&S®VSE-KT10
Amplifier measurements	R&S®VSE-K18	R&S®VSE-KT18
Transient measurements	R&S®VSE-K60	R&S®VSE-KT60
Vector signal analysis	R&S®VSE-K70	R&S®VSE-KT70
3GPP WCDMA uplink and downlink signal analysis, including HSDPA, HSUPA and HSPA+	R&S®VSE-K72	R&S®VSE-KT72
WLAN signal analysis, in line with the WLAN IEEE 802.11a/b/g/n/p/ac/ax standard	R&S®VSE-K91	R&S®VSE-KT91
Analysis of user-defined OFDM and OFDMA signals	R&S®VSE-K96	R&S®VSE-KT96
LTE and LTE-Advanced signal analysis	R&S®VSE-K100/-K102/-K104	R&S®VSE-KT100/-K102/-K104
LTE narrowband IoT analysis	R&S®VSE-K106	R&S®VSE-KT106
3GPP 5G NR downlink and uplink measurement application	R&S®VSE-K144	R&S®VSE-KT144
3GPP 5G NR downlink MIMO measurements	R&S®VSE-K146	R&S®VSE-KT146
3GPP 5G NR Release 16 extension for uplink/downlink	R&S®VSE-K148	R&S®VSE-KT148
HRP UWB measurements	R&S®VSE-K149	R&S®VSE-KT149
O-RAN measurements	R&S®VSE-K175	R&S®VSE-KT175
User-defined frequency correction by SnP file	R&S®VSE-K544	R&S®VSE-KT544
Software maintenance	R&S®VSE-SWM	

<sup>6)</sup> Can be installed and run either on an oscilloscope or on an external PC.

<sup>7)</sup> Can only be installed and run on the oscilloscope it was purchased for.

#### Step 4: choose hardware options

Replacement SSD (Windows 10)	R&S®RTP-B19
Front handles	R&S®RTP-B20
Adapter, rear option slot	R&S®RTP-B21

#### Memory upgrade

100 Msample per channel	R&S®RTP-B101
200 Msample per channel	R&S®RTP-B102
500 Msample per channel	R&S®RTP-B105
1 Gsample per channel	R&S®RTP-B110

#### Step 5: choose accessories

High-impedance buffer amplifier, incl. 500 MHz passive probe	R&S®RT-Z1M
Front cover	R&S®RTP-Z1
Hard case	R&S®RTP-Z4
Precision BNC to SMA adapter	R&S®RT-ZA16
High-precision and low-loss matched cable pair, length: 1 m	R&S®RT-ZA17
Rackmount kit	R&S®ZZA-KN6

#### Step 6: choose warranty and services

##### Warranty

Base unit	3 years
All other items <sup>9)</sup>	1 year

##### Service options

Extended warranty, one year	R&S®WE1	Please contact your local Rohde & Schwarz sales representative.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

<sup>9)</sup> For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

## Service that adds value

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

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- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

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